ELECTRONIC TOOLS FOR INDUSTRY

MODEL 803, 803R
DC - AC DIFFERENTIAL VOLTM
TEMPORARY INSTRUCTION M

john fluke MANUFACTURING CO., INC.
SEATTLE, WASHINGTON

MODEL 803, 803R
DC - AC DIFFERENTIAL VOLTMETER
TEMPORARY INSTRUCTION MANUAL

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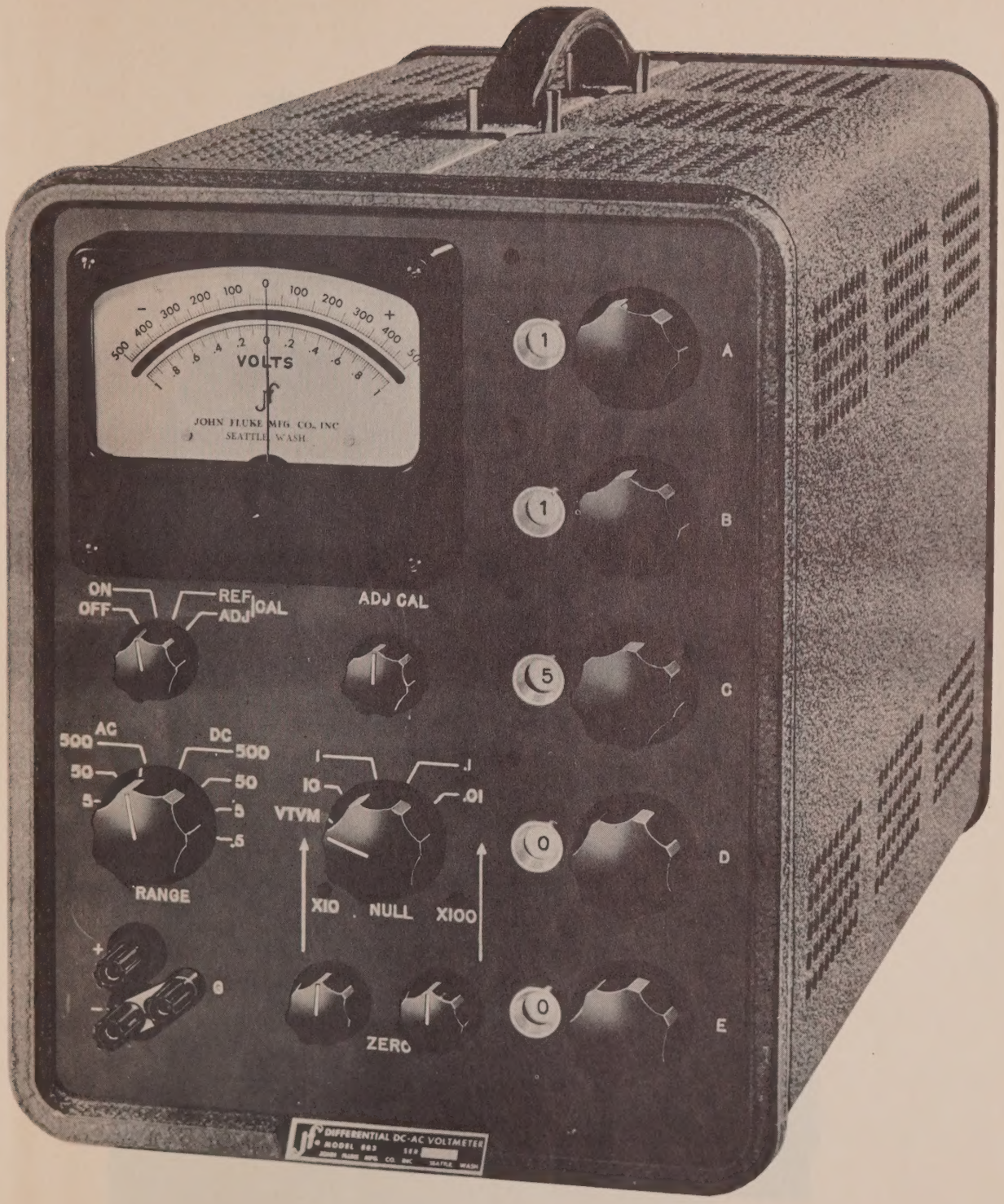
PRELIMINARY
INSTRUCTION
MANUAL
FOR

MODEL 803, 803R

PRECISION DC - AC DIFFERENTIAL VOLTMETER

SERIAL NUMBER 254/232 AND ABOVE


VOLTS
JOHN FLUKE MFG. CO., INC.
SEATTLE, WASH.
ON
OFF
REF ADJ
CAL
ADJ CAL
A
B
C
D
E
AC
DC
500
50
5
.5
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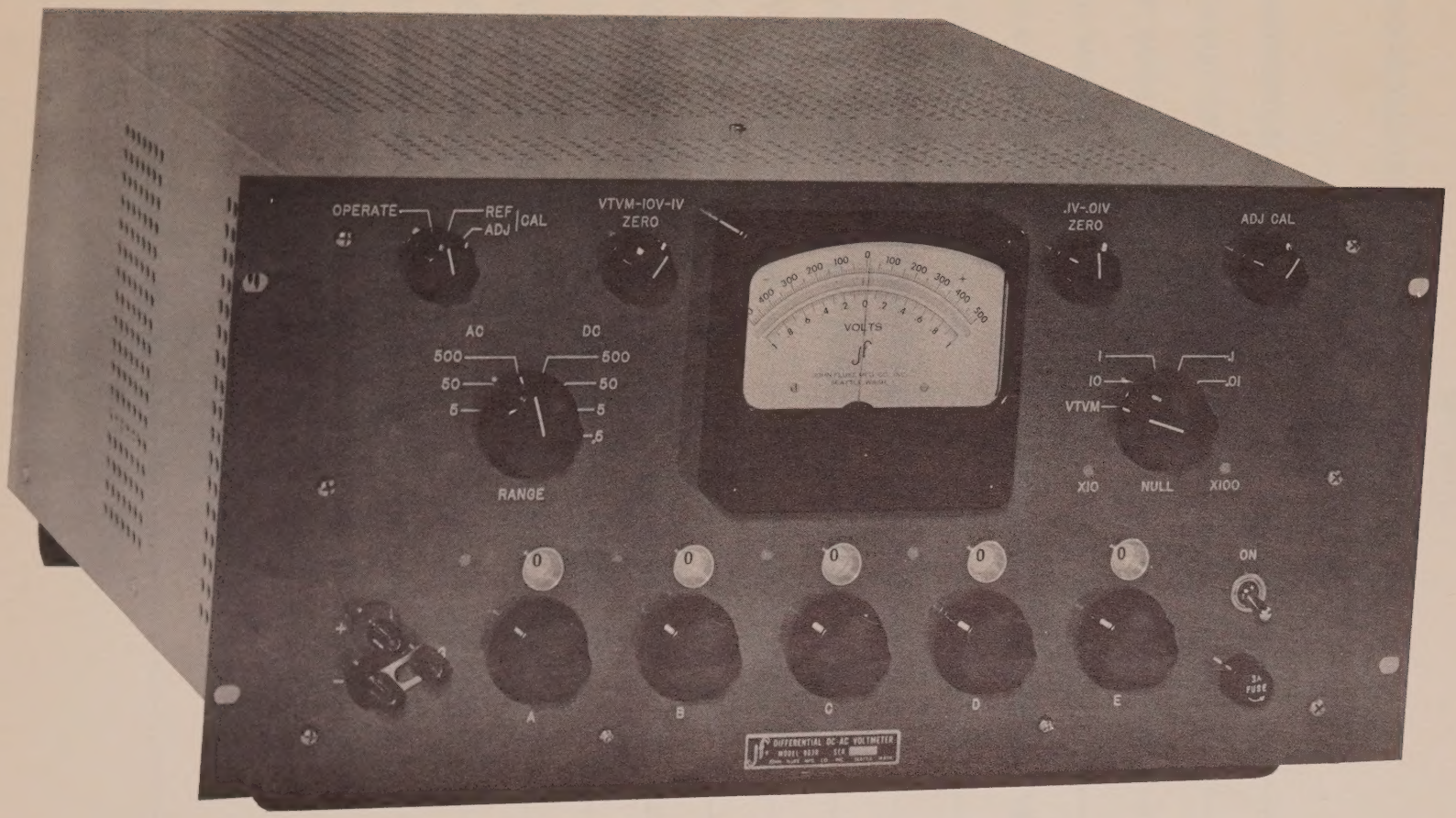
DIFFERENTIAL DC-AC VOLTMETER
MODEL 803


OPERATE
REF
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VTVM-10V-1V
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.1V-.01V
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1
10
.01
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X10
NULL
X100
ON
3A
FUSE
A
B
C
D
E
DIFFERENTIAL DC AC VOLTMETER

MODEL 803 DC - AC DIFFERENTIAL VOLTMETER

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SECTION I.

MODEL 803 DC - AC DIFFERENTIAL VOLTMETER

SPECIFICATIONS

AS A DIFFERENTIAL VOLTMETER

VOLTAGE RANGES:

Input Voltage Range	Recommended Null Range	Input Impedance At Null	Input Impedance 1% Off Null
DC: 50-500	10-0-10	INFINITE	100M
	1-0-1	"	1000M
5-50	1-0-1	"	1000M
	.1-0-.1	"	1000M
.5-5	.1-0-.1	"	1000M
	.01-0-.01	"	1000M
0-.5	.1-0-.1	"	1000M
	.01-0-.01	"	1000M
AC: 50-500	10-0-10	1M, 25 uuf	1M, 25 uuf
	1-0-1	"	"
5-50	1-0-1	"	"
	.1-0-.1	"	"
.05-5	.1-0-.1	"	"
	.01-0-.01	"	"

RESOLUTION:

Input Voltage Range	Dial Resolution (Volts)	Meter Resolution (Volts)
DC: 50-500	.01	.005
5-50	.001	.0005
.5-5	.0001	.00005
0-.5	.00001	.00005
AC: 50-500	.01	.005
5-50	.001	.0005
.05-5	.0001	.00005

ACCURACY:

DC: ±.05% of input voltage from .1 to 500V

±0.1% of input voltage or .00005V, whichever is greater from 0 to .1V.

AC: ±.2% of input voltage from .5 to 500V, reduced accuracy from .05 to .5V.

AS A VACUUM TUBE VOLTMETER

VOLTAGE RANGES:

	Input Voltage Range	Input Impedance
DC:	± 500	10M
	± 50	10M
	± 5	10M
	± .5	10M
	± 10 *	10M
	± 1 *	10M
	± .1 *	1M
	± .01 *	1M
AC:	0-500	1M, 25 uuf
	0-50	"
	0-5	"
	0-100 *	"
	0-10 *	"
	0-1 *	"
	0-.1 *	"
	0-.01 *	"

* Using Null Ranges

GENERAL SPECIFICATIONS

REFERENCE STABILITY:

±.01% for 25% change in line voltage
±.01% per hour after 30 minute warmup

AC TO DC CONVERTER FREQUENCY RESPONSE:

30 cps to 5000 cps

INPUT POWER:

150 watts at 117/234 volts, 50/60 cycles

SIZE:

Cabinet Model - 13"H x 9-3/4"W x 16"D
Rack Model - 8-3/4"H x 19"W x 17-5/16"D

WEIGHT:

Cabinet Model - 30 pounds
Rack Model - 33 pounds

PRICE: $875 Cabinet Model, f.o.b. Factory
$895 Rack Model, f.o.b. Factory

JOHN FLUKE MFG. CO., INC., P. O. BOX 7161, SEATTLE 33, WASH.

SECTION II.

MODEL 803, 803R

ADDENDUM

WARNING. For maximum accuracy, the 500 volt reference supply must be calibrated against the standard cell with the range switch in the 500 volt DC position.

MODEL 803

PRECISION DC - AC DIFFERENTIAL VOLTMETER

INSPECTION

This instrument has been thoroughly checked and tested before being shipped from the factory. Upon receipt of the instrument, inspect carefully for any damage which may have been incurred in transit. Reference should be made to the WARRANTY section of this instruction manual for the procedure to be followed if any shipping damage has occurred.

INITIAL OPERATION

Connect the instrument to a 105 - 130 volt, 50 - 60 cycle power source. It can be used with a 234 volt, 60 cycle power source by changing jumpers as indicated on the reference power supply board and changing the main fuse from 3a to 1.5a. Set the RANGE switch to the 500V DC position, the NULL switch to the VTVM position, all 5 voltage dials to zero, and then turn the POWER switch to the ON position. The decimal lamps will indicate when power is applied. Allow the instrument to warm up for 5 to 10 minutes before making adjustments.

Adjust the VTVM, 10V, 1V ZERO potentiometer for zero meter deflection. Turn the NULL switch to the .01V position. Adjust the .1V, .01V ZERO potentiometer for zero deflection. Turn the NULL switch back to the VTVM position.

Calibrate the internal 500 volt reference supply by first turning the POWER switch to the CAL REF position. Then hold the POWER switch in the CAL ADJ position and adjust the ADJ CAL potentiometer for zero reading on the meter. Turn the POWER switch back to the ON position when calibration is completed. The instrument is now ready for use.

TO MEASURE DC VOLTAGES

First determine the approximate value of the unknown voltage. With the RANGE switch set to the 500V DC position and the NULL switch set to the VTVM position, connect the voltage to be measured to the positive and negative binding posts. If the meter reads to the left, reverse the input connections. The positive binding post (red) on the instrument must always be positive with respect to the negative binding post (black) when making differential dc measurement since the internally generated voltage is always positive. A ground shorting link can be connected to either binding post depending upon the external circuit conditions. Always set the RANGE switch to the lowest range which will give an on-scale reading.

Now determine the precise value of the unknown voltage. Set the 5 voltage dials to the approximate voltage indicated on the meter. Be sure to observe the decimal lights. Then turn the NULL switch to the 10V sensitivity (full scale sensitivity) and trim the voltage dials for zero meter deflection. Then

turn the NULL switch to the increased sensitivities, always keeping the meter deflection zero by means of the voltage dials. Finally, when the NULL switch is in the .01V position the unknown voltage can be read directly from the 5 dials.

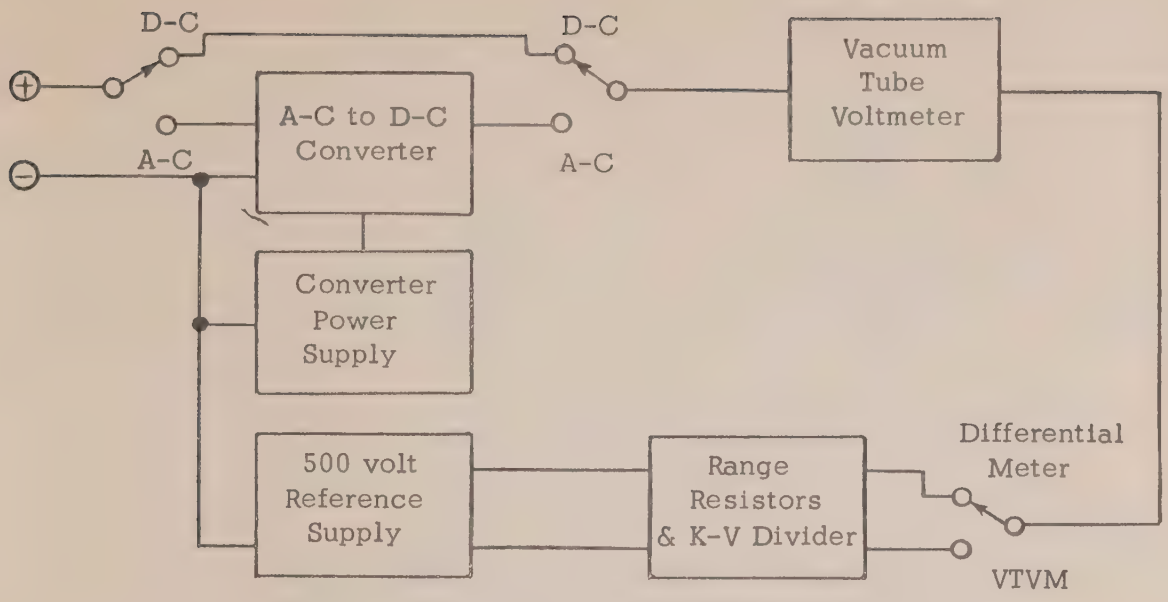
TO MEASURE AC VOLTAGES

Ac voltages are measured in a manner identical to that used for dc voltages, except that the RANGE switch must be set to the ac ranges. A ground shorting link must always be connected to the negative binding post when making differential ac measurements, however. This is to reduce the effect of electric fields within the instrument.

TO OBSERVE EXCURSIONS OF A VOLTAGE ABOUT A NOMINAL VALUE

Set up the nominal voltage on the 5 voltage dials and observe the excursions directly on the meter on one of the 4 null ranges. Use recommended null ranges where possible. A right hand deflection of the meter indicates the voltage under observation has increased above the nominal value by the amount indicated. Note that the output of the converter always utilizes the basic 5 volt dc range, regardless of input voltage. This influences the sensitivity of the null ranges when making ac measurements. Therefore, the basic null sensitivity must be multiplied by a factor of 10 when measuring between 5 and 50 volts ac and by 100 when measuring 50 to 500 volts ac, as indicated by the null multiplier lamps.

It should be noted that most ac power sources are not especially amplitude stable. This is also true of most laboratory oscillators. The output amplitude of many oscillators is extremely sensitive to mechanical vibration and line voltage fluctuations for example. Under normal conditions the 803 does not introduce noise or variations in the reading.



803 BASIC BLOCK DIAGRAM

The Model 803 Precision DC-AC Differential Voltmeter operates on the basic principle of comparing an unknown voltage with an adjustable known voltage, and any difference between the two is indicated on a sensitive null detector. The circuit consists of 5 main elements which are:

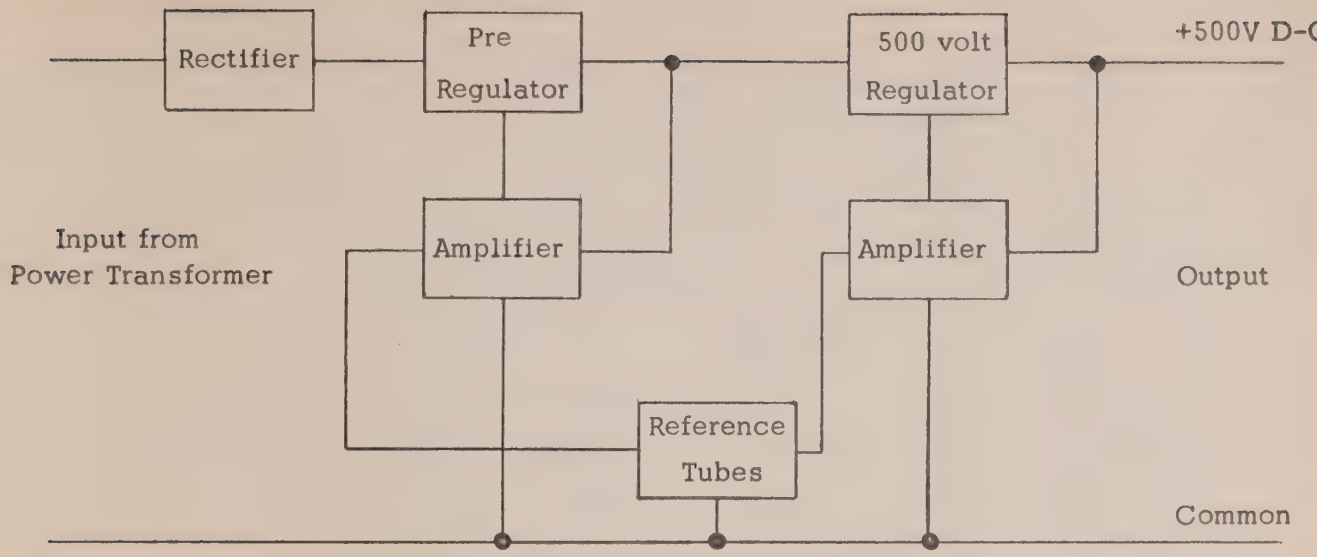
1. An extremely stable 500 volt dc reference supply, with a means for setting this reference to 500 volts ±.01%.

2. A network of range resistors for dividing the 500 volt reference down to three lower reference voltages of 50, 5, and 0.5 volts, and a precision 5-dial Kelvin-Varley divider for selecting an accurate, known portion of one of the four reference voltages.

3. A calibrated multi-range VTVM which is used both as a conventional VTVM for determining the approximate value of the unknown voltage and as a null detector for measuring the difference between the unknown voltage and the internally generated known voltage.

4. An ac to dc converter which is used for all ac measurements to convert an unknown ac voltage to an unknown dc voltage, which in turn is compared with the internally generated known dc voltage.

5. A well-regulated converter power supply which provides plate and filament power for the ac to dc converter.



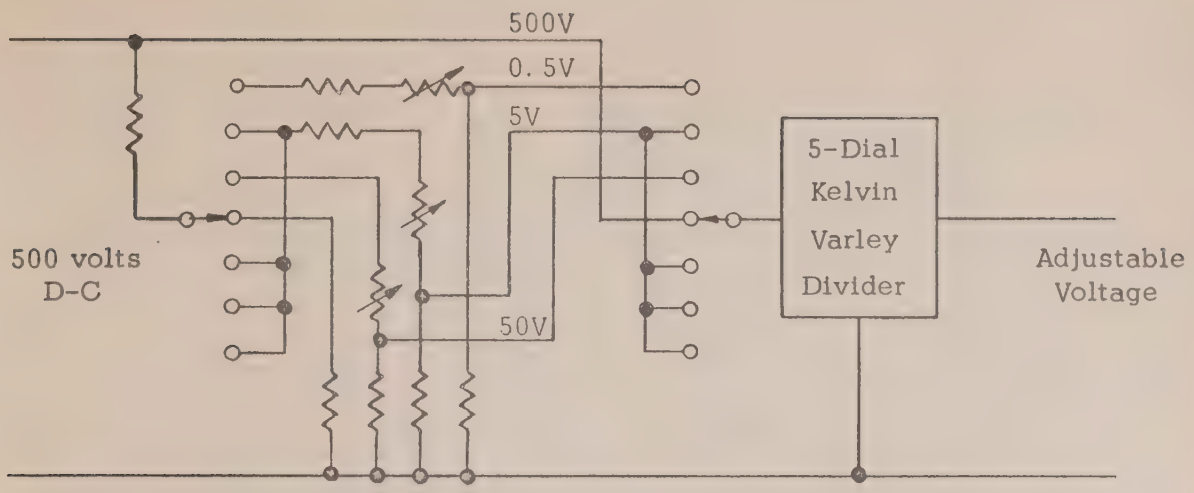
500 VOLT REFERENCE SUPPLY BLOCK DIAGRAM

The 500 volt reference supply is the source of the internally generated known dc voltage Its basic elements are:

1. A pre-regulator which supplies approximately +625 volts dc to the main regulator.

2. A +500 volt dc regulator which supplies the reference voltage.

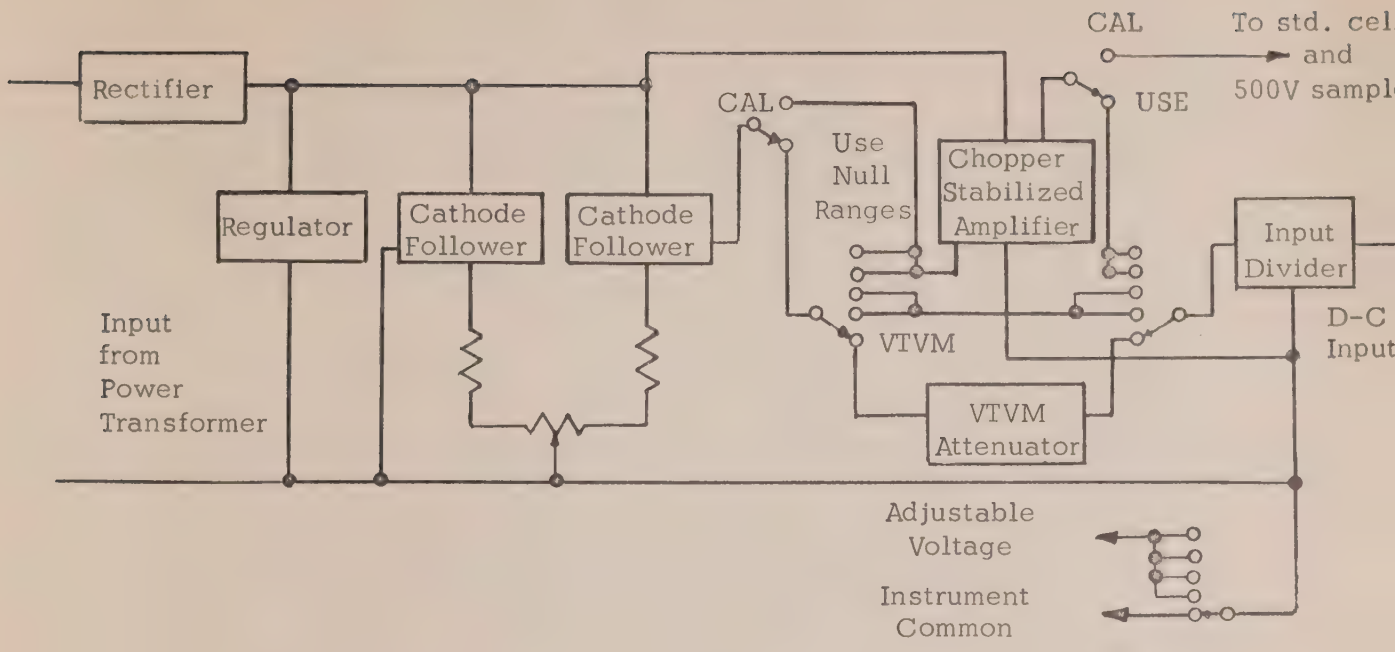
This supply is extremely well regulated, with the output changing less than .01% due to line voltage fluctuations or ambient temperature changes. A resistive sample string monitors the 500 volts and is calibrated at the factory to give an output exactly equal to the potential of an internal standard cell when the reference is 500 volts ±.01%. This supply should be calibrated after a warm-up period if precise measurements are to be made.



RANGE RESISTORS & K-V DIVIDER BLOCK DIAGRAM

The range resistors are utilized to provide four accurate reference voltages of 500, 50, 5, and .5 volts. The five-dial Kelvin-Varley divider is utilized to select an accurately known portion of one of the calibrated reference voltages. This then becomes the internally generated known voltage, which is compared with the unknown voltage. The accuracy of the Kelvin-Varley divider is maximum when the ratio of output voltage to input voltage is as high as possible. Therefore, it is best to make a precise measurement with the range switch in the position which results in the unknown voltage being as close to, but not exceeding, the maximum voltage allowable for that range.

The Kelvin-Varley divider is made of matched, precision resistors. If any of the resistors in the five-dial divider become defective, send the resistor value and serial number of the instrument to John Fluke Mfg. Co., Inc., where a record is kept of the exact values used in each instrument shipped. In this way a replacement can be obtained which will not upset the matching of the other resistors on the particular switch.



VTVM BLOCK DIAGRAM

The VTVM circuit is utilized for all measurements. Its basic elements are:

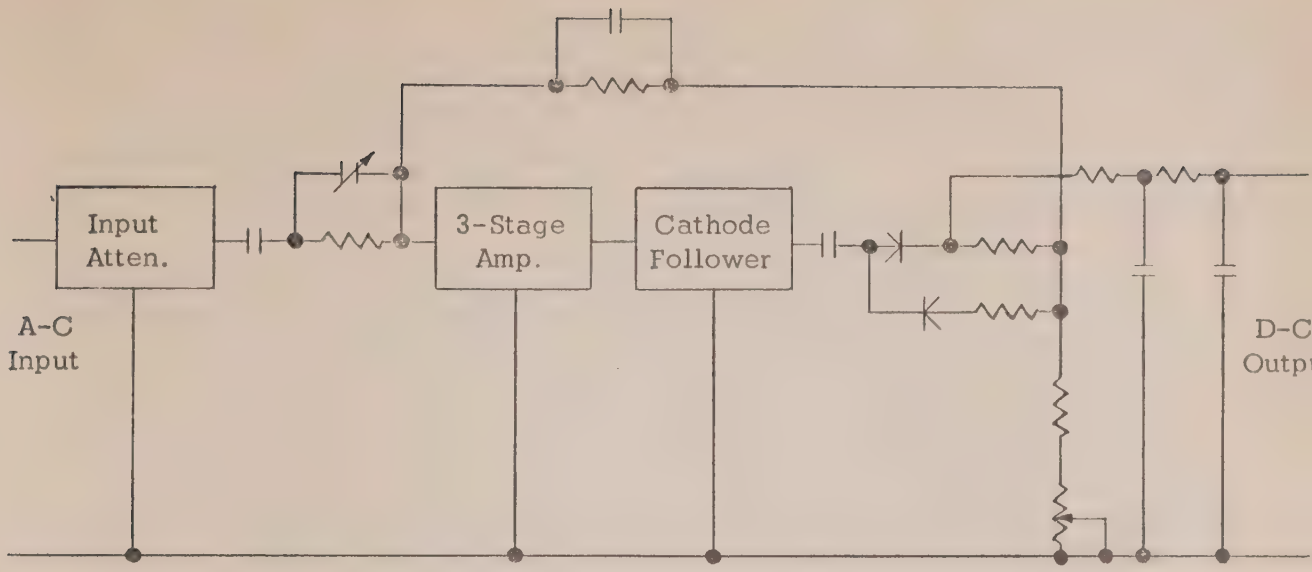
1. A simple +105 volt regulator which supplies plate power for the rest of the circuit.

2. A cathode follower type VTVM.

3. A chopper stabilized amplifier which is used in the two most sensitive null ranges.

4. Associated divider networks which are used for the various ranges and null sensitivities.

The common bus in the VTVM circuit is connected to the instrument common (negative binding post) when the null switch is in the VTVM position and to the internally generated known voltage from the Kelvin-Varley divider with the switch in all null range positions. Thus, at null, there is zero potential across the input divider and zero current flows in the input circuit. The cathode follower type VTVM has a basic full scale sensitivity of .5 volts dc. Therefore, a chopper stabilized amplifier with fixed gain is required to the .1 volt and .01 volt null ranges.



A-C TO D-C CONVERTER BLOCK DIAGRAM

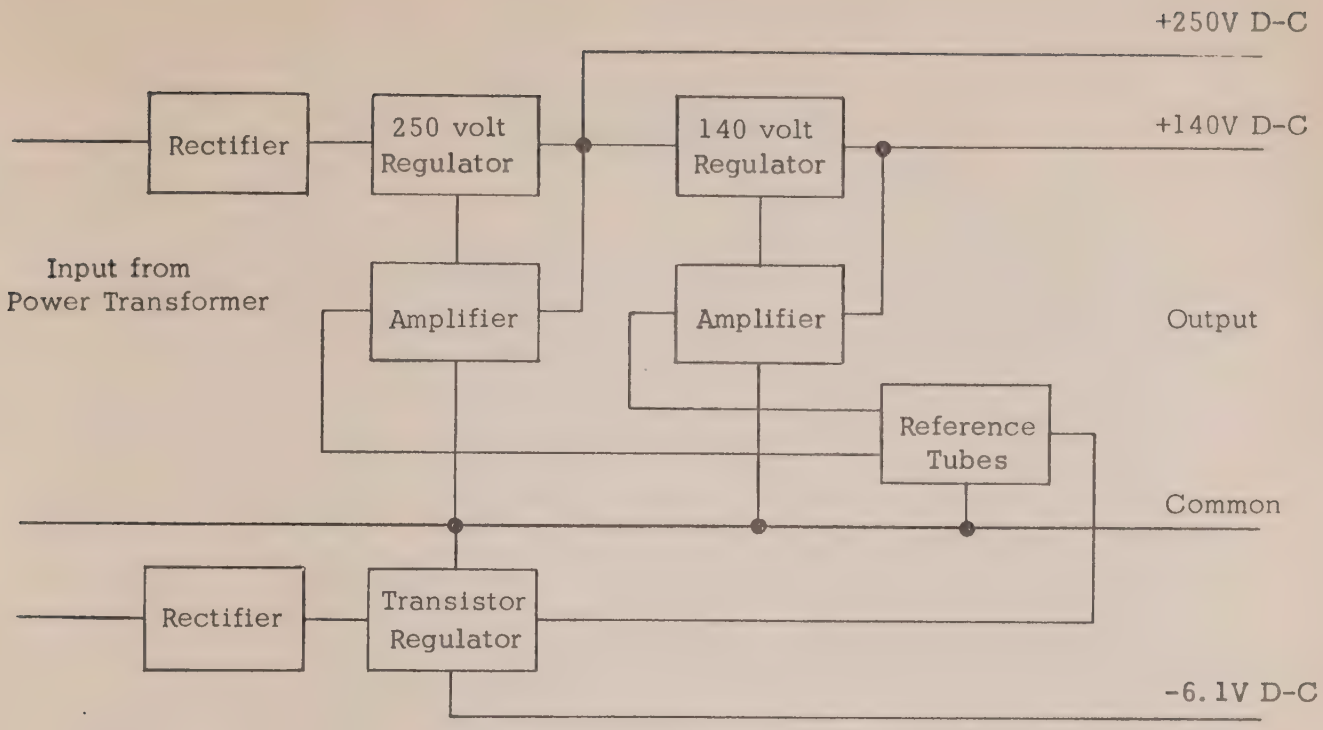
The ac to dc converter is utilized for all ac measurements. Its basic elements are:

1. A precision input attenuator which allows the converter to operate at the same voltage level for all three ac ranges.

2. A high-gain three-stage feedback amplifier with a cathode follower output.

3. A half-wave silicon diode rectifier and filter network which provides a dc output.

The ac to dc converter gives a dc output of 5 volts for an ac input of 5 volts rms. The converter always operates between 0.5 volts and 5 volts because of the input attenuator. The closed loop gain of the amplifier is approximately 2.5 and the open loop forward gain is centered about 26,400. The gain of the amplifier is flat in the mid-band and is down 3db at 30 cps and 5 kc. The primary feedback is full-wave and is a function of the current through the silicon diodes. The dc output is proportional to the average value of the ac input wave, and is calibrated to indicate the rms value.



CONVERTER POWER SUPPLY BLOCK DIAGRAM

The basic elements of the converter power supply are:

1. A +250 volt dc regulator which supplies plate power for the high-gain stage and cathode follower in the converter.

2. A +140 volt dc regulator which supplies plate power for the two lower-gain stages and all screen power in the converter.

3. A transistor regulator which supplies filament power of -6.1 volts dc for all filaments in the converter.

It is important that the plate supply for the output stages in the converter and that the converter filament supply be well regulated to avoid undesirable transients due to line voltage fluctuation when making ac measurements.

803 READING ERROR
HARMONIC DISTORTION

Harmonic	% Distortion	% Error*	
		Max. Positive	Max. Negative
Any even harmonic	.1	.000	
	.5	.001	
	1.0	.005	
	2.0	.020	
Third	.1	.033	.033
	.5	.168	.167
	1.0	.338	.328
	2.0	.687	.667
Fifth	.1	.020	.020
	.5	.101	.099
	1.0	.205	.195
	2.0	.420	.380

* Depends upon phase relationship between harmonic and fundamental for odd harmonics - error can be any value between maximum positive and maximum negative, including zero.

MODEL 803 RECALIBRATION INSTRUCTIONS

The calibration of the Model 803 should be done in a draft-free area and in an ambient temperature of 72°F ±5°F tc insure maximum accuracy under typical laboratory operating conditions. The dc and ac sections of the instrument are calibrated independently, but the dc section must be in calibration before calibrating the ac section. The ground post should be tied to the negative binding post during calibration, and be sure instrument is properly warmed up.

DC CALIBRATION

To calibrate the basic 500 volt dc range set the 5 voltage dials to 499910, the RANGE switch to the 500V DC position, and the NULL switch to the 1V sensitivity. Adjust the VTVM-10V-1V ZERO potentiometer for zero meter deflection. Apply a known 500 volts dc (accurate to .01% or better) to the input posts of the instrument and adjust the meter to zero by means of the ADJ CAL potentiometer. Turn the POWER switch to the CAL REF position; then hold the POWER switch in the CAL ADJ position, adjusting R-36 for zero reading on the meter. Turn the POWER switch back to the ON position when this step is completed; meter should still read zero. If the ADJ CAL potentiometer is not approximately centered, turn it to a center position and adjust R-31 to zero the meter. Recheck the calibration by setting up the instrument in a normal manner (with the use of the internal standard cell) and measuring the known 500 volts.

The 50, 5, and 0.5 volt dc ranges are calibrated after the basic 500 volt range is in calibration. Again set the 5 voltage dials to 499910, the RANGE switch to appropriate dc range, and the NULL switch to the .01V sensitivity. Adjust the .1V - .01V ZERO potentiometer for zero meter deflection. Apply a known voltage equal to the full scale value of the range being calibrated (accurate to .01% or better) to the input posts of the instrument. Adjust the meter to zero by means of R-124 for the 50 volt range, R-126 for the 5 volt range, and R-129 for the 0.5 volt range. The dc section of the instrument is now calibrated.

A very effective independent check of the entire instrument, especially the 5 volt range, consists of measuring the emf of a standard cell which has been recently certified by a standards group. This furnishes a known emf of a value which will read out on all 5 dials in the 5 volt range. The Model 803 should read well within ±.03% of the certified value of the known cell.

AC CALIBRATION

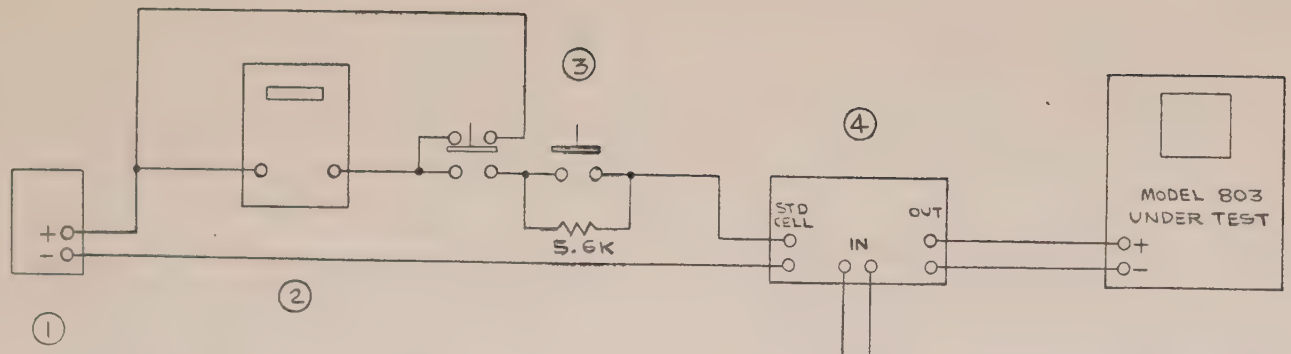
The ac section is calibrated after the dc section is in calibration. To calibrate the basic 5 volt ac range set the 5 voltage dials to zero, the RANGE switch to the 5V DC position, and the NULL switch to the .01V sensitivity. Adjust the .1V - .01V ZERO potentiometer for zero meter deflection. Turn the

NULL switch to the VTVM position and the RANGE switch to the 5V AC position. Place a short across the positive and negative binding posts and turn the NULL switch to the .01V sensitivity. Adjust R-426 for zero meter deflection (a long time constant in associated circuits makes this adjustment more time consuming than normal). Turn the NULL switch to the VTVM position, remove the short from across the binding posts, and turn the 5 voltage dials to 499910. Apply a stable, low distortion (total harmonic distortion of .1% or less) 400 cycle sine wave with a known amplitude of 5 volts (accurate to .05% or better) to the input posts of the instrument. Turn the NULL switch to the .01V sensitivity and adjust the meter to zero by means of R-423. Turn the NULL switch to the VTVM position and apply a known 5 volt, 5,000 cycle sine wave to the instrument. Turn the NULL switch to the .01V sensitivity and adjust the meter to zero by means of C-8.

Turn the NULL switch to the VTVM position, the RANGE switch to the 50V AC position and apply a known 50 volt, 400 cycle sine wave to the instrument. Turn the NULL switch to the .01V sensitivity and adjust the meter to zero by means of R-3. Turn the NULL switch to the VTVM position and apply a known 50 volt, 5,000 cycle sine wave to the instrument. Turn the NULL switch to the .01V sensitivity and adjust the meter to zero by means of C-3.

Turn the NULL switch to the VTVM position, the RANGE switch to the 500V AC position and apply a known 500 volt, 400 cycle sine wave to the instrument. Turn the NULL switch to the .01V sensitivity and adjust the meter to zero by means of R-7. Turn the NULL switch to the VTVM position and apply a known 500 volt, 5,000 cycle sine wave to the instrument. Turn the NULL switch to the .01V sensitivity and adjust the meter to zero by means of C-5. Turn the NULL switch to the VTVM position. The a-c section of the instrument is now calibrated.

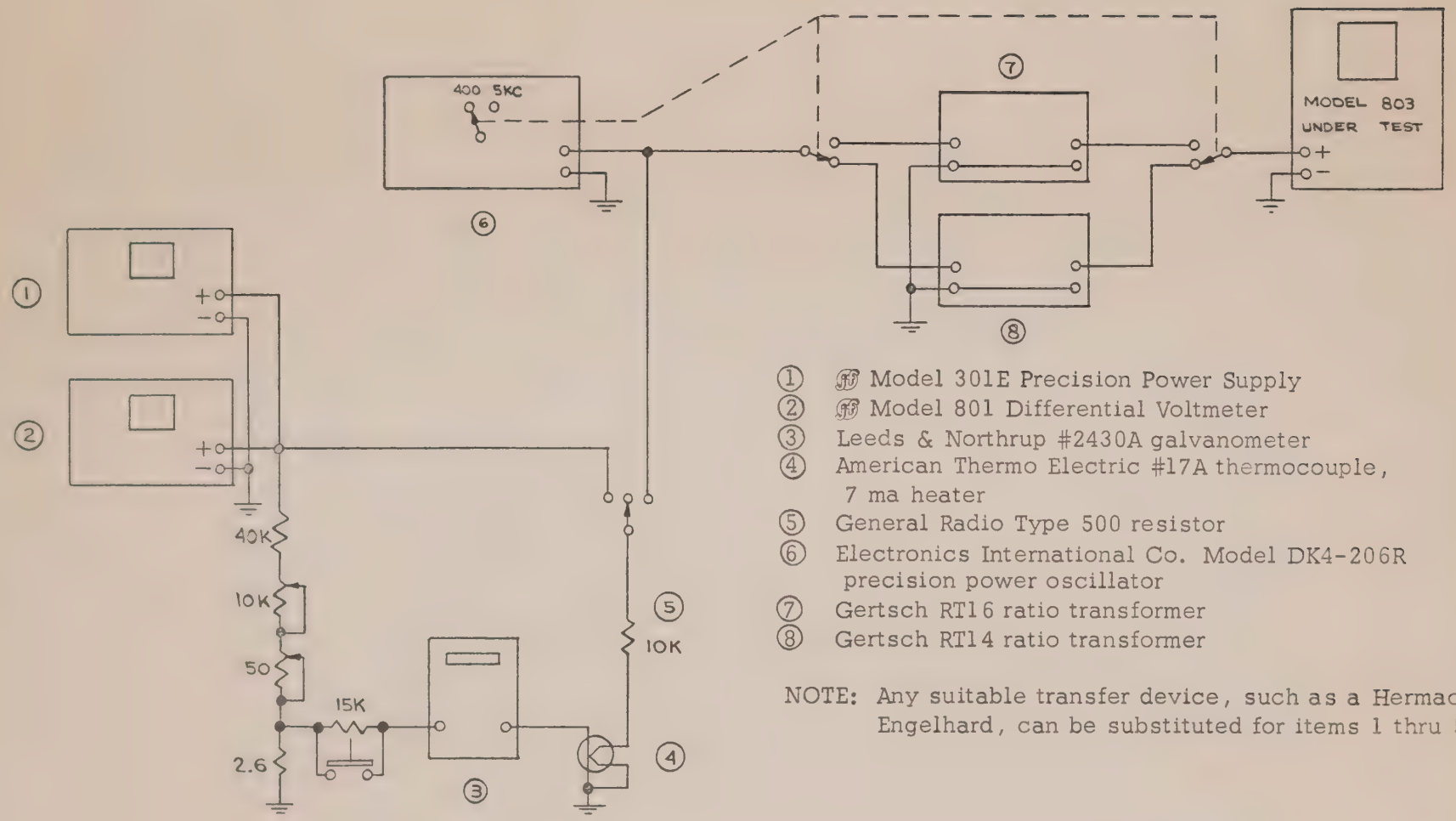
MODEL 803
RECOMMENDED CALIBRATION SET-UP
DC SECTION



① Eppley #100A standard cell
② Leeds & Northrup #2430A galvanometer
③ Momentary push button switches with fine silver contacts
④ Electro Measurements #X194 precision voltage divider
⑤ Ⓕ Model 301E Precision Power Supply

FIGURE I

MODEL 803
RECOMMENDED CALIBRATION SET-UP
AC SECTION



① Model 301E Precision Power Supply
② Model 801 Differential Voltmeter
③ Leeds & Northrup #2430A galvanometer
④ American Thermo Electric #17A thermocouple, 7 ma heater
⑤ General Radio Type 500 resistor
⑥ Electronics International Co. Model DK4-206R precision power oscillator
⑦ Gertsch RT16 ratio transformer
⑧ Gertsch RT14 ratio transformer

NOTE: Any suitable transfer device, such as a Hermach-Engelhard, can be substituted for items 1 thru 5.

FIGURE II

SECTION III.

MODEL 803

LIST OF REPLACEABLE PARTS

CIRCUIT SYMBOL	DESCRIPTION	FLUKE STOCK NO.
B1	Standard cell, non-saturated low hysteresis	X223
B201	Mercury bias cell, 1.35 v	X44
C1,2	Capacitor, oil 1 mfd, 1000 v	CO20
C3,5,8	Capacitor, ceramic, variable 0.8 - 4.5 mmf	CA4
C6,6A	Capacitor, ceramic 300 mmf, 600 v	CT13
C7	Capacitor, mylar .47 mfd, 600 v	CP21
C9	Capacitor, ceramic 20 mmf, 600 v	CT14
C10,14	Capacitor, paper .1 mfd, 600 v	CP5
C11,302,305 306,309	Capacitor, paper .1 mfd, 400 v	CP4A
C12	Capacitor, paper .01 mfd, 1600 v	CP1
C13	Capacitor, paper .002 mfd, 400 v	CT9
C101	Capacitor, mylar 1 mfd, 600 v	CP26
C102	Capacitor, polystyrene 1 mfd, 200 v	CO22
C103	Capacitor, metalized mylar .47 mfd, 600 v	CP25

CIRCUIT SYMBOL	DESCRIPTION	FLUKE STOCK NO.
C201/202	Capacitor, electrolytic 10/10 mfd, 450 v	CE13
C203	Capacitor, mylar .02 mfd, 600 v	CP18
C204,205,206, 207,209	Capacitor, paper .047 mfd, 400 v	CP6
C208	Capacitor, paper 220 mmf, 600 v	CT1
C210	Capacitor, paper .01 mfd, 600 v	CP7
C211,212	Capacitor, mylar .22 mfd, 400 v	CP19
C301/304	Capacitor, electrolytic 10/10 mfd, 500 v	CE20
C303,405	Capacitor, paper .047 mfd, 400 v	CP6A
C307,310	Capacitor, electrolytic 8 mfd, 250 v	CE10
C308	Capacitor, electrolytic 4000 mfd, 15 v	CE23
C401,406	Capacitor, electrolytic 150 mfd, 150 v	CE22
C402,407, 409,411	Capacitor, paper .01 mfd, 400 v	CP16
C403, 408, 413	Capacitor, electrolytic 100 mfd, 6 v	CE21
C404, 410	Capacitor, paper .47 mfd, 200 v	CP24
C414	Capacitor, ceramic 680 mmf, 600 v	CT3

CIRCUIT SYMBOL	DESCRIPTION	FLUKE STOCK NO.
C415	Capacitor, mylar 5 mfd, 200 v	CP22
C416	Capacitor, metalized paper 2 mfd, 200 v	CP14
C417	Capacitor, metalized paper 1 mfd, 200 v	CP17
C418	Capacitor, electrolytic 290 mfd, 3 v	CE24
CH201	Chopper, SPDT 6.3 v, 60 cycles	X100
F1	Fuse, 3 amp.	F3
I-103-108	Lamp, neon, NE2E	X40B
J1	Connector, 18 pin female	X150
J2	Connector, 10 pin female	X151
J3	Connector, 24 pin female	X254
J4	Connector, 9 pin male	X149
J5	Connector, 4 pin female	X177
J101	Binding post, red insulators	X219, X217
J102	Binding post, black insulators	X219, X218
J103	Binding post, metal spacer	X219, X220
M101	Meter, 50-0-50 microamp. with special scale	M31
P101	Connector, 24 pin male	X255
P102	Connector, 9 pin female	X153

CIRCUIT SYMBOL	DESCRIPTION	FLUKE STOCK NO.
P103	Connector, 4 pin male	X178
R1,8	Resistor, precision metal film 1 m, 1%, 1/2 w	DRMF71
R2	Resistor, precision metal film 122 K, 1%, 1/2 w	DRMF61
R3	Resistor, wirewound, variable 5 K, 10%, 1/4 w	P5000TA
R4,5	Resistor, precision metal film 500 K, 1%, 1/2 w	DRMF63
R6	Resistor, precision metal film 10 K, 1%, 1/2 w	DRMF51
R7	Resistor, wirewound, variable 500Ω, 10%, 1/4 w	P500T
R9	Resistor, precision metal film 200 K, 1%, 1/2 w	DRMF62
R10	Resistor, composition 390Ω, 10%, 1 w	GB3911
R11,314	Resistor, composition 470 K, 10%, 1/2 w	EB4741
R12,19	Resistor, composition 22 K, 10%, 1 w	GB2231
R20	Resistor, deposited carbon 500 K, 1%, 2 w	DR620
R21	Resistor, deposited carbon 144 K, 1%, 1 w	DR67
R22,216,217	Resistor, composition 39 K, 10%, 1 w	GB3931
R23,25,29, 213,214,218, 220,223,308, 311,316,406, 413	Resistor, composition 1 M, 10%, 1/2 w	EB1051

CIRCUIT SYMBOL	DESCRIPTION	FLUKE STOCK NO.
R24	Resistor, precision wirewound 149 K, 1/2 % , 1 w	PR611
R26,27	Resistor, deposited carbon 300 K, 1%, 1 w	DR614
R28,306	Resistor, deposited carbon 250 K, 1%, 1 w	DR613
R30	Resistor, precision wirewound 320 K, .1%, 1 w	PR614
R31,426	Resistor, wirewound variable 5 K, 10%, 1/4 w	P5000T
R32	Resistor, precision wirewound 158 K, .1%, 1 w	PR620
R33,34	Resistor, precision wirewound 125 K, .1%, 1 w	PR610
R35	Resistor, precision wirewound 509Ω, .1%, 1/2 w	PR37
R36	Resistor, wirewound, variable 5Ω, 20%, 2 w	P5A
R101	Resistor, composition 270Ω, 10%, 1 w	GB2711
R102	Resistor, deposited carbon 20 K, 1%, 1/2 w	DR53
R116	Resistor, deposited carbon 10 K, 1%, 1/2 w	DR51
R103	Resistor, deposited carbon 4.4 M, 1%, 1/2 w	DR74
R104,106	Resistor, deposited carbon 4.5 M, 1%, 1/2 w	DR75
R105	Resistor, deposited carbon 4.99 M, 1%, 1/2 w	DR76
R107	Resistor, deposited carbon 500 K, 1%, 1/2 w	DR618

CIRCUIT SYMBOL	DESCRIPTION	FLUKE STOCK NO.
R108,112	Resistor, deposited carbon 900 K, 1%, 1/2 w	DR622
R109	Resistor, deposited carbon 103.5 K, 1%, 1/2 w	DR63
R110,111	Resistor, deposited carbon 9 M, 1%, 1/2 w	DR78
R113	Resistor, deposited carbon 9.9 M, 1%, 1/2 w	DR79
R114,313,319	Resistor, deposited carbon 90 K, 1%, 1/2 w	DR513
R115	Resistor, deposited carbon 9.99 M, 1%, 1/2 w	DR711
R117,210	Resistor, wirewound, variable 5 K, 10%, 2 w	P5KA
R118,224	Resistor, wirewound, variable 10 K, 10%, 2 w	P10KA
R119	Resistor, wirewound, variable 1 K, 10%, 2 w	P1000A
R120,121	Resistor, precision wirewound 112.375 K, .05%, 1 w	PR615
R122,414	Resistor, composition 27 K, 10%, 1 w	GB2731
R123	Resistor, precision wirewound 28.571 K, .05%, 1/2 w	PR515
P124,126,129	Resistor, wirewound, variable 500Ω, 10%, 1/4 w	P500T
R125	Resistor, precision wirewound 2.5317 K, .05%, 1/2 w	PR49
R127	Resistor, precision wirewound 22.5 K, .1%, 1/2 w	PR513

CIRCUIT SYMBOL	DESCRIPTION	FLUKE STOCK NO.
R128	Resistor, precision wirewound 250.31Ω, .05%, 1/2 w	PR311
R130	Resistor, precision wirewound 24.75 K, .1%, 1/2 w	PR514
*R131-136	Resistor, precision wirewound 40 K, .02%, 1/2 w, matched	PR512
*R137-147	Resistor, precision wirewound 8 K, .05%, 1/2 w, matched	PR48
*R148-158	Resistor, precision wirewound 1.6 K, .1%, 1/2 w, matched	PR46
*159-169	Resistor, precision wirewound 320Ω, .1%, 1/2 w, matched	PR39
*R170-179	Resistor, precision wirewound 64Ω, .1%, 1/2 w, matched	PR24
R180,181,303, 305,320,321	Resistor, composition 150 K, 10%, 1/2 w	EB1541
R182	Resistor, composition 1 K, 10%, 1 w	GB1021
R201,202	Resistor, composition 56Ω, 10%, 1 w	GB5601
R203,204	Resistor, composition 2.7 K, 10%, 1 w	GB2721
R205-209	Resistor, composition 4.7 K, 10%, 1 w	GB4721
R211,212	Resistor, deposited carbon 8.2 K, 1%, 1/2 w	DR411
R215,324, 325	Resistor, composition 10 K, 10%, 1 w	GB1031
R219,228, 404,405	Resistor, composition 2.2 M, 10%, 1/2 w	EB2251

CIRCUIT SYMBOL	DESCRIPTION	FLUKE STOCK NO.
R221	Resistor, deposited carbon 2.2 M, 1%, 1/2 w	DR73
R222,410, 411	Resistor, composition 10 M, 10%, 1/2 w	EB1061
R225	Resistor, deposited carbon 5 K, 1%, 1/2 w	DR49
R226,227, 304	Resistor, composition 220 K, 10%, 1/2 w	EB2241
R301,302	Resistor, composition 10Ω, 10%, 1 w	GB1001
R307	Resistor, deposited carbon 125 K, 1%, 1/2 w	DR629
R309,310	Resistor, composition 680 K, 10%, 1/2 w	EB6841
R312	Resistor, deposited carbon 45 K, 1%, 1 w	DR58
R315	Resistor, composition 100 K, 10%, 1/2 w	EB1041
R317	Resistor, deposited carbon 100 K, 1%, 1/2 w	DR61
R318	Resistor, deposited carbon 40 K, 1%, 1 w	DR57
R322	Resistor, deposited carbon 3.89 K, 1%, 1/2 w	DR414
R323,424, 425	Resistor, deposited carbon 50 K, 1%, 1/2 w	DR59
R326	Resistor, composition 15 K, 10%, 1 w	GB1531
R327	Resistor, wirewound 7.5Ω, 5%, 5 w	R7.5W

CIRCUIT SYMBOL	DESCRIPTION	FLUKE STOCK NO.
R401, 407 408	Resistor, composition 3.3 K, 10%, 1 w	GB3321
R402	Resistor, composition 1.5 K, 10%, 1 w	GB1521
R403,409	Resistor, composition 220Ω, 10%, 1/2 w	EB2211
R412	Resistor, composition 360Ω, 5%, 1 w	GB3615
R415	Resistor, composition 560Ω, 10%, 1/2 w	EB5611
R416	Resistor, composition 100Ω, 10%, 1/2 w	EB1011
R417-419	Resistor, composition 33 K, 10%, 1 w	GB3331
R420,421	Resistor, precision metal film 22 K, 1%, 1/2 w	DRMF52
R422	Resistor, precision metal film 2.4 K, 1%, 1/2 w	DRMF42
R423	Resistor, wirewound, variable 100Ω, 10%, 1/4 w	P100T
R427	Resistor, composition 4.7 M, 10%, 1/2 w	EB4751
S101	Switch, rotary 3 pole, 4 position Cabinet model 803 Rack model 803	 803-808 803R-804
S102	Switch, rotary 10 pole, 7 position	SR39
S103	Switch, rotary 6 pole, 5 position	SR29
S104	Switch, rotary 2 pole, 5 position	SR40

CIRCUIT SYMBOL	DESCRIPTION	FLUKE STOCK NO.
S105, 106 107	Switch, rotary 2 pole, 10 position	SR41
S108	Switch, rotary 2 pole, 11 position	SR42
SC301,302	Rectifier, silicon 50 v, 1 amp.	RE8
SC201,202, 303	Diode, silicon 600 v PIV, .5 amp.	RE10
SC401,402	Rectifier, silicon 40 v, 2 ma	RE7
T1	Transformer assembly, harnessed Cabinet model 803 Rack model 803R	 803-416 803R-406
TR1	Transistor, power	2N301
TR301,302	Transistor, NPN junction	2N214
V1	Vacuum tube, Rectifier, 5Y3GT	5Y3GT
V2,305	Vacuum tube Pentode, 6AQ5A	6AQ5A
V3	Vacuum tube Pentode, 6AU6	6AU6
V4,202,308	Vacuum tube, Voltage regulator, OA2	OA2
V5,204,404	Vacuum tube, Duo triode, 12AU7	12AU7
V6,7,307, 309	Vacuum tube, Voltage reference, OG3	OG3

CIRCUIT SYMBOL	DESCRIPTION	FLUKE STOCK NO.
V8,206,304	Vacuum tube, Duo triode, 12AX7	12AX7
V201	Vacuum tube, Current regulator, 9-7	9-7
V203	Vacuum tube, Voltage regulator, OB2	OB2
V205	Vacuum tube, Triode, 6C4	6C4
V301	Vacuum tube, Rectifier, 6X4	6X4
V302	Vacuum tube, Beam power, 5881	5881
V303,306	Vacuum tube, Triode-Pentode, 6AW8	6AW8
V310	Lamp, neon NE2E	NE2E
V401-403	Vacuum tube, Pentode, 6DK6	6DK6
	Knob, 1-1/2" with pointer	X234
	Knob, 1-1/2" without pointer	X207
	Knob, 1" with pointer	X231
	Dial, voltage readout	X251
	Bezel, readout hole, long	803-234
	Bezel, readout hole, short	803-232
	Retainer ring, bezel	X161
	Lens, plexiglass	803-235
	Retainer ring, plexiglass lens	X189

CIRCUIT SYMBOL	DESCRIPTION	FLUKE STOCK NO.
	Cord, power	X27E
	Strain relief, power cord	X212
	Feet, rubber mounting	X224
	Handle assembly	X241 407-201 (2) X248 (4)
	Fuse holder	X12
	Washer, insulating, flat	X93
	Washer, insulating, shoulder	X93A
	Washer, nylon, thick	X277
	Washer, nylon, thin	X276
	Washer, mylar	803-231

* These resistors are factory matched for each instrument. When ordering, specify instrument serial number for each resistor ordered.

SECTION IV.

WARRANTY

The JOHN FLUKE MFG. CO., INC. warrants each instrument manufactured by them to be free from defects in material and workmanship. Their obligation under this Warranty is limited to servicing or adjusting an instrument returned to their factory for that purpose, and to making good at their factory any part or parts thereof; except tubes, fuses, choppers and batteries, which shall, within one year after making delivery to the original purchaser, be returned by the original purchaser to them with transportation charges prepaid, and which on their examination shall disclose to their satisfaction to have been thus defective. If the fault has been caused by misuse or abnormal conditions of operation repairs will be billed at cost. In this case, an estimate will be submitted before work is started, if requested.

If any fault develops, the following steps should be taken:

1. Notify us, giving full details of the difficulty, and include the Model number, type number, and serial number. On receipt of this information we will give you service data or shipping instructions.

2. On receipt of the shipping instructions, forward the instrument prepaid, and repairs will be made at the factory. If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the Warranty.

SHIPPING

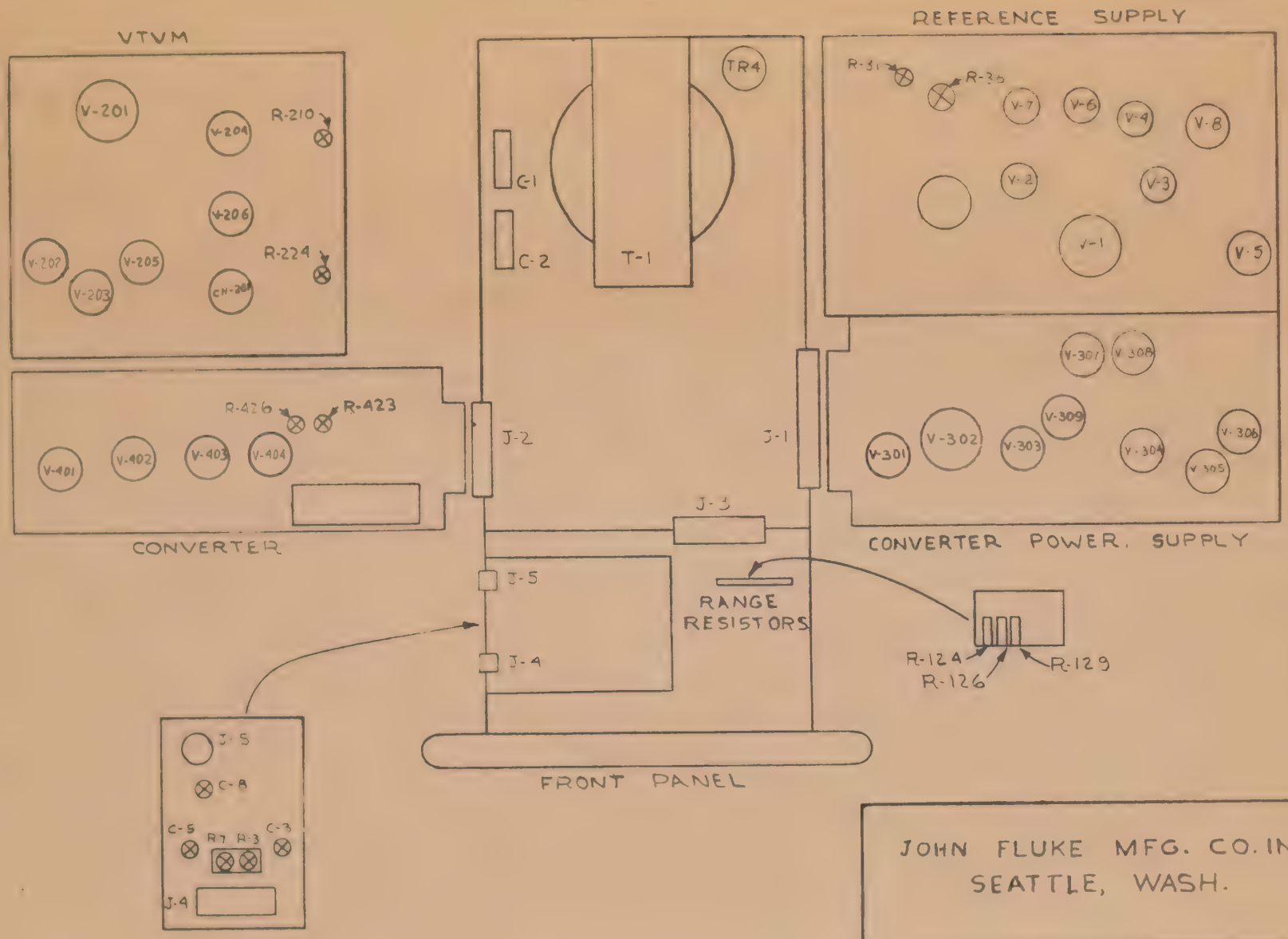
All shipments of JOHN FLUKE MFG. CO., INC. instruments should be made via Railway Express prepaid. The instrument should be shipped in original packing carton, or if not available any suitable container that is rigid. If substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be thoroughly inspected immediately upon receipt of same. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If it fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to us. We will then advise you of the disposition to be made of the equipment and arrange for repair or replacement. Include Model number, type number, and serial number when referring to this instrument for any reason.

Do not hesitate to contact us concerning any questions which you may have about this instrument. The JOHN FLUKE MFG. CO., INC. will be happy to answer all application questions which will enhance your use of this instrument.

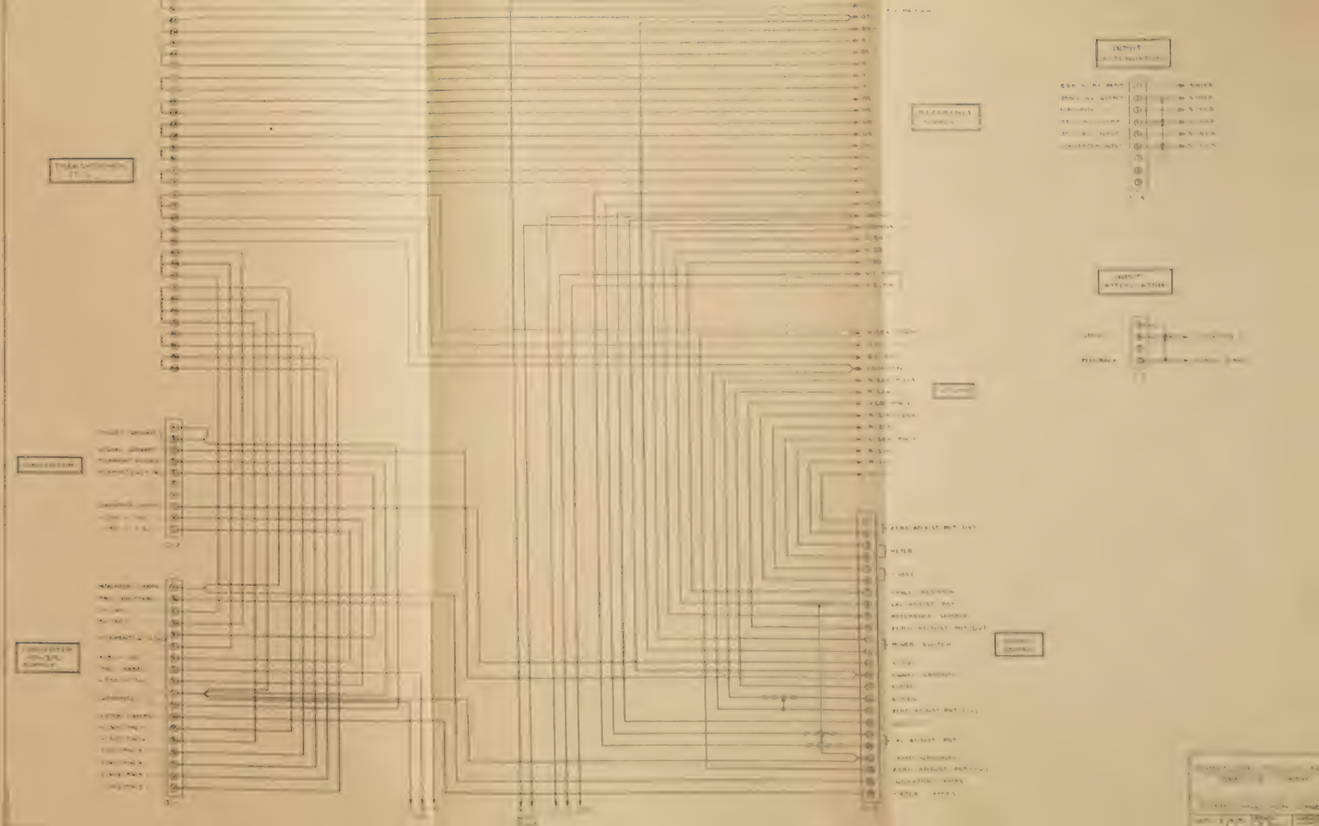
JOHN FLUKE MFG. CO., INC., P. O. BOX 7161, SEATTLE 33, WASHINGTON

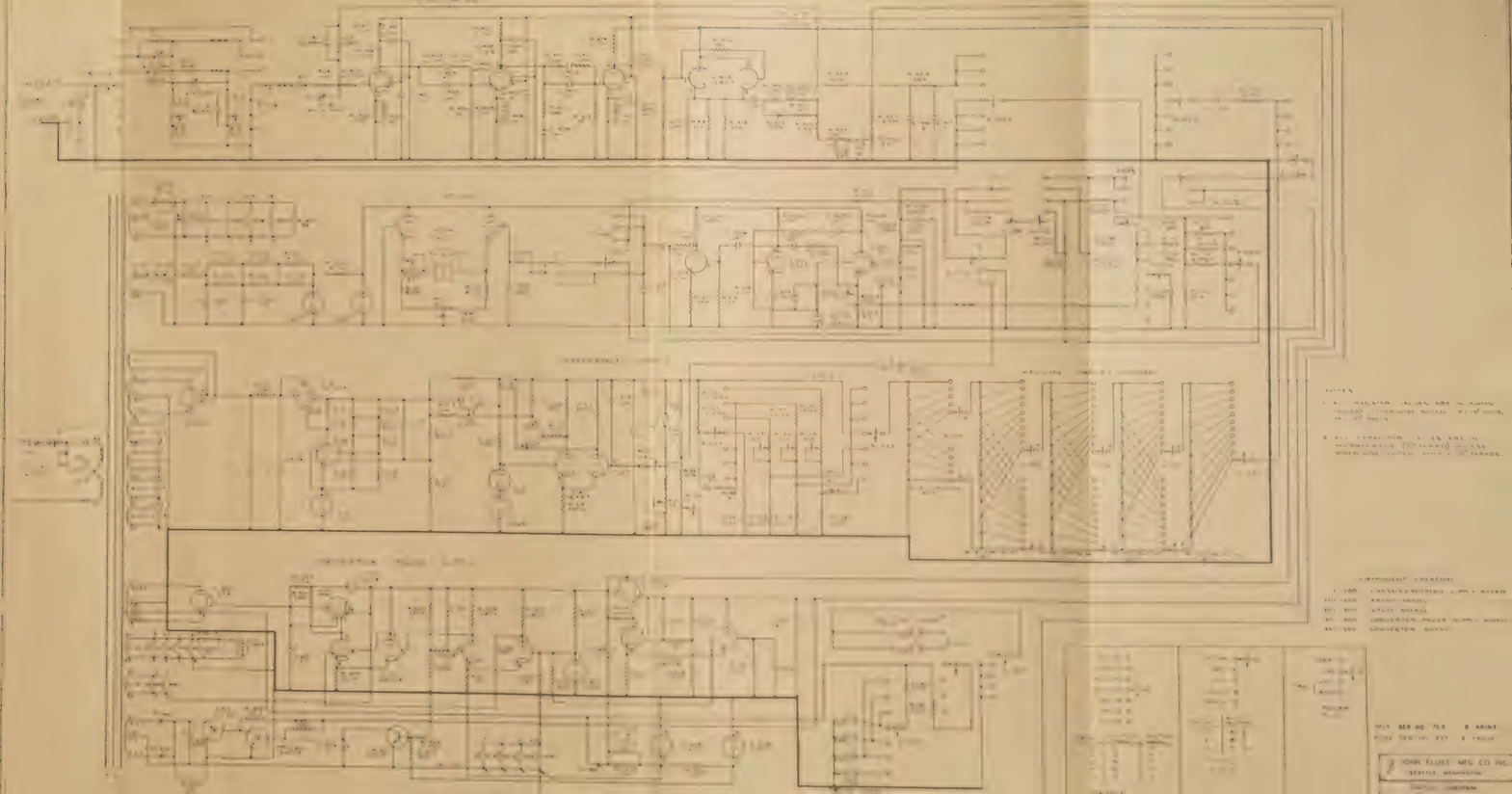


JOHN FLUKE MFG. CO. INC.
SEATTLE, WASH.

COMPONENT LOCATION

DATE - 2/4/9	DRAWN B. BARR	CHECKED
MODEL - 803	803-104	





C-59 CATALOG

- VAW METER
- POWER SUPPLIES
  - Precision calibrated
  - Nuclear — High Voltage
  - High resolution
  - High stability
- PRECISION DC POTENTIOMETRIC VOLTMETERS
- PRECISION DC-AC DIFFERENTIAL VOLTMETER

john fluke MANUFACTURING COMPANY, INC.

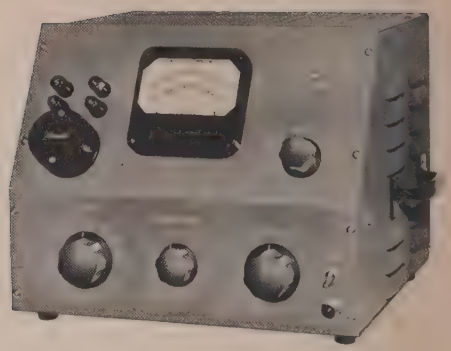
7100 220TH S.W. · MOUNTLAKE TERRACE, WASHINGTON

P.O. BOX 7161, SEATTLE 33, WASHINGTON

VAW METER

MODEL 102

For Measuring Volts—Amperes—Watts



FEATURES

- 20 CPS to 20 KC
- 10% and Unity Power Factor Ranges
- 1.5 to 600 Volts AC
- .0015 to 30 Amperes
- Negligible Circuit Burden
- True Electrodynamometer Action

The Model 102 VAW METER is an electronic instrument for the measurement of voltage (V), current (A) and power (W) over a wide range of frequency, voltage, current and power factor. Voltage, current and power readings are made directly on a linear meter scale. Owing to its high sensitivity, the VAW METER is characterized by its ability to read power from microwatts to kilowatts. Its high input impedance and low shunt drop produce negligible insertion effects on the circuit under test. Power readings are inherently without waveform error for all frequency components within specified frequency range. The VAW METER is ideally suited to measuring true power consumed by a wide variety of loads including both linear and non-linear elements such as servo components, transformers, rectifiers and substantially any power consuming circuit configuration. Additionally, it will be found exceptionally useful in measuring amplifier output power into the actual amplifier load, obsoleting the substitution method of utilizing resistance loading for estimating amplifier's power output.

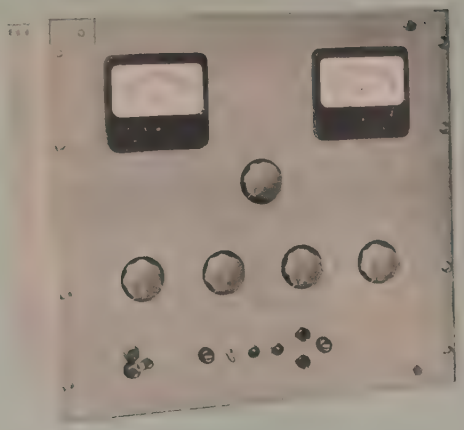
SPECIFICATIONS

Frequency Range:	20 CPS to 20 KC.
Voltage Ranges:	1.5, 3, 6, 15, 30, 60, 150, 300, 600 volts RMS full scale; selected by voltage range switch on front panel.
Current Ranges:	.0015, .003, .006, .015, .03, .06, .15, .3, .6, 1.5, 3, 6, 15, 30 RMS amperes full scale; selected by plugging in shunts on the front panel.
Power Ranges:	Wattmeter readings are direct readings in watts taking into account the "Power Factor" switch setting of either .1 or 1. With the "Power Factor" switch set at 1 the wattmeter reads VA cos o; with this switch set at .1 the wattmeter reads .1 VA cos o. Thus the full-scale watts range from 225 microwatts to 18 kilowatts, or the product of any full-scale current, any full-scale voltage and either .1 or 1.
Shunt Drop:	45 millivolts at full-scale current.
Input Resistance:	1 megohm for all voltage ranges.
Accuracy:	Better than 3% of full scale within the rated frequency range.
Meter Scales:	Voltage, current and power are read on the same meter arcs by selection of the desired quantity by positioning the "VAW" switch.
Input Voltage:	105 to 130 volts 50/60 CPS only.
Accessories:	The Model 102 VAW Meter is supplied with one shunt of any value listed above under "Current Ranges" as selected by the purchaser. Additional shunts may be purchased as extra equipment.
Mounting:	Smooth grey baked enamel on front panel, machine engraved. Grey wrinkle on case exterior. Over-all dimensions are 13" W x 10" H x 12" D, exclusive of handles and knobs.
Net Weight:	35 pounds.
Shipping Weight:	52 pounds.
Price:	$555.00 F.O.B. Factory, Seattle, Washington, with one shunt of listed rating. Additional shunts are $20.00 each F.O.B. Factory.

PRECISION POWER SUPPLY

MODEL 301C

1.02 — 1012 VDC



FEATURES

- 1.02 to 1012 VDC — 0 to 400 MA
- .005% Regulation
- Chopper Stabilized
- Standard Cell Reference
- 500 Microvolt Resolution
- .1% Calibration Accuracy

The Model 301C is a chopper stabilized, standard cell referenced, calibrated precision DC power supply which will satisfy the most exacting requirements of laboratory or production line.
With its 400 milliampere, 1 KV output, it is truly a brute force supply. Because of extremely conservative transformer design it may be operated at full load indefinitely with no ill effects.
Five decade voltage controls afford resolution of .5 millivolt over the entire operating range, and absolute accuracy is better than .1%. Use of a standard cell reference and chopper stabilization imparts to the 301C output voltage stability of better than .01% long term.

A unique hinged panel affords instant access to the printed circuitry without removing the instrument from its rack. This construction also isolates the standard cell and precision wirewound sampling strings for all heat generating elements. A compact, rugged unit of incomparable performance, the 301C stands alone in its field.

SPECIFICATIONS

Input Voltage:	117 volts, 50/60 cycles. Can be supplied for 234 volts 50/60 cycles
Input Power:	875 watts fully loaded, 190 watts standby
Output Voltage:	1.02 to 1012 volts DC
Output Current:	0 to 400 milliamperes
Output Polarity:	Either side may be grounded, or both sides may be left floating
Output Connector:	Gen. Rad. binding posts on ¾" centers
Regulation vs. line:	.005% or 1 mitlivolt for 10% line voltage change
Regulation vs. load:	.005% or 1 millivolt for 200 milliampere load current change
Stability:	.005% per hour after short warm-up, less than .01% per day
Reference element:	Low hysteresis standard cell
Equating element:	Type A-12 low noise chopper
Ripple:	Less than 2 millivolts RMS
Voltage Calibration:	9 —100 volt steps 10— 10 volt steps 10— 1 volt steps 10— .1 volt steps 1 — .11 volt vernier
Voltage Resolution:	.5 millivolt at any output voltage via .11 volt Vernier
Voltage Resettability:	.01%
Calibration Accuracy:	.1% or 2 millivolts
Meters:	4" Voltmeter 0-1000 volts 4" Milliammeter 0-500 milliamps
Size:	19" W x 17½" H x 15" D. Panel slotted to RMA standards. Equipped with hardwood skids for bench use
Net Weight:	120 pounds
Shipping Weight:	133 pounds
Price:	$985.00 F.O.B. Factory, Seattle, Washington

PRECISION POWER SUPPLY

MODEL 301E

1.02 — 512 VDC

The Model 301E, like the Model 301C, is a chopper stabilized, ultra stable, calibrated power supply. The specifications for the Model 301E are identical to those of the 301C, with the following exceptions:

SPECIFICATIONS

Input Voltage:	117/234 volts, 50/60 cycles, single phase
Input Power:	350 watts fully loaded, 110 watts standby
Output Voltage:	1.02 volts to 512 volts DC
Output Current:	0 to 300 milliamperes
Regulation vs. Load:	.005% or 1 millivolt for 150 milliampere load current change
Voltage Calibration:	4—100 volt steps 10— 10 volt steps 10— 1 volt steps 1— .11 volt vernier
Size:	19" W x 8¾" H x 18" D Panel slotted to RMA standards. Equipped with resilient feet for bench use.
Net Weight:	37 pounds
Shipping Weight:	55 pounds
Price:	$595.00 F.O.B. Factory, Seattle, Washington

HIGH RESOLUTION DC POWER SUPPLY

MODEL 406

FEATURES

- 0 to 530 Volts DC
- 0 to 100 Milliamperes
- .01 % Line and Load Regulation
- 2 Millivolt Resolution
- .01 % Short Term Stability
- 1 Millivolt Maximum Ripple
- Dual Range Bias and 6.3 V AC 3 Amp. Outputs

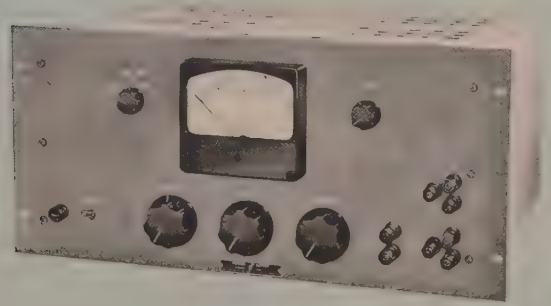
HIGH STABILITY, HIGH RESOLUTION SUPPLY FOR INSTRUMENT CALIBRATION WORK

The Model 406 incorporates features which make it an ideal laboratory or general purpose power supply. Use of differential type equating circuits and precision wire-wound sampling circuits impart to the Model 406 a degree of stability seldom encountered outside the most expensive laboratory supplies. Coarse, fine and vernier output voltage controls permit setting the output of the Model 406 to within 2 mv. of any value desired over its entire range. A high voltage "OFF" position is provided on the meter circuit switch for disconnecting the high voltage from main output posts without affecting other outputs.

The Model 406, when used with the John Fluke Model 800 Differential Voltmeter, provides the most convenient and economical DC calibrating team available. Light weight, compact, and highly portable, the Model 406 is an ideal laboratory power supply, a rugged production line unit, and an excellent stable voltage source for DC instrument calibration work.

SPECIFICATIONS

Input Voltage:	117 volts, 50/60 cycles. Can be supplied for 234 volts, 50/60 cycles.
Output Voltage:	0 to 530 volts dc
Output Current:	0 to 100 milliamperes
Regulation:	.01% or 50 millivolts for line voltage variation from 105 to 130 volts .01% or 50 millivolts for load current changes from 0 to 100 milliamperes
Stability:	.01% or 50 millivolts per hour .05% or 250 millivolts per day
Ripple:	1 millivolt or less
Voltage Resolution:	2 millivolts over entire range via vernier control



MODEL 406R

Output Polarity:	Either positive or negative side of output may be grounded, or both sides may be left floating. Two supplies may be series connected with either side of either supply grounded.
Auxiliary Outputs:	(DC) 0 to —225 volts and 0 to —22.5 volts bias supply. Positive side connected to negative side of main output. Line regulation .02%. 1 mv max. ripple. Output impedance 0 to 10,000 ohms depending on setting of bias control. (AC) 6.3 volts at 3 amperes unregulated; winding insulated for 1000 volts rms. to ground.
Size:	Cabinet Model: 9¾" W x 13" H x 14" D Rack Model: 19" W x 8¾" H x 16¾" D
Net Weight:	Cabinet Model: 28 pounds Rack Model: 35 pounds
Shipping Weight:	Cabinet Model: 35 pounds Rack Model: 44 pounds
Price:	Cabinet Model: $285.00 F.O.B. Factory, Seattle, Washington Rack Model: $285.00 F.O.B. Factory, Seattle, Washington

Where applications require deleting all output terminals from front panel, the Model 406A (Cabinet Model) is available at $320.00 F.O.B. Factory, Seattle, Washington. All outputs plus the AC input are brought out through an AN 3102-28-9P connector located on the rear of the case.

HIGH RESOLUTION DC POWER SUPPLY

MODEL 407

FEATURES

- 0 to 555 VDC — 0 to 300 MA
- .01% Regulation
- .05% Long Term Stability
- Dual Bias and Filament Outputs
- 2 Millivolt Resolution
- Excellent for Instrument Calibration

The Model 407 is unquestionably the finest DC supply of its type available today. Through the use of silicon rectifiers, printed circuitry and light-weight aluminum construction, the size and weight of this unit have been kept to the absolute minimum consistent with the high order of performance and reliability associated with the John Fluke name.

The extreme stability of this supply is due in large part to the use of highest quality precision wirewound resistors in sampling circuits, and at all critical points. All potentiometers are likewise wirewound and the reference tube is an aged unit operated at constant current. Accordingly, the voltage controls are calibrated and may be used for the direct calibration of multimeters and panel instruments. A high voltage "OFF" position is provided on the meter circuit switch for disconnecting the high voltage from main output posts without affecting other outputs.

The high order of regulation against both line voltage and load current changes results from the use of balanced equating circuits, heater voltage stabilization and pentode series passing and amplifier tubes.

SPECIFICATIONS

Input Voltage:	117/234 volts, 50/60 cycles
Input Power:	425 watts fully loaded, 100 watts standby
Main Output Voltage:	0 to 555 volts DC
Main Output Current:	0 to 300 milliamperes
Regulation:	.01% or 50 millivolts for line voltage variation from 105 to 130 volts. .01% or 50 millivolts for load current change from 0 to 300 milliamperes
Output Impedance:	Less than .5 ohm DC to 100 KC at max. output
Stability:	.01% or 50 millivolts per hour .05% or 250 millivolts per day
Ripple:	1 millivolt RMS or less
Voltage Resolution:	2 millivolts over entire range via 0 to .55V control
Voltage Controls:	0 to 500 volts, ten 50 volt steps 0 to 55 volts, smoothly variable 0 to .55 volts, smoothly variable
Calibration Accuracy:	Better than .5% from 50 to 500 volts when set up by the 0-500 volt control.
Output Polarity:	Either positive or negative side of main output may be grounded, or both sides may be left floating. Two supplies may be series connected with either side of either supply grounded.
Meter:	Illuminated 4½-inch square meter with MTR. CKT. switch for selectively reading HV output voltage, BIAS output voltage and HV output current. Switch also disconnects HV output from output binding posts when turned to extreme CCW position.
Meter Ranges:	0 to 300 milliamperes 0 to 600 volts with MTR. RANGE switch in 600 V position. 0 to 60 volts with MTR. RANGE switch in 60 V position.
Auxiliary Outputs:	(DC) 0 to —250 volts and 0 to —25 volts bias supply, variable via BIAS control. Max. current output 5 milliamperes at 250 volts. Positive side connected to negative side of main output. Line regulation .02%. 1 millivolt max. ripple. Output impedance 0 to 10,000 ohms depending on setting of bias control. At 250 volt setting load regulation .01% for 5 milliampere load change. (AC) Two independent 6.3 volt 5 amp. outputs. Each winding insulated for 1500 volts RMS to ground. Phasing indicated at binding posts for series or parallel connections.
Output Connectors:	All outputs brought out to binding posts on ¾" centers. Also brought out to terminal strip at rear on rack mounting model.
Size:	Cabinet Model: 9¾" W x 13" H x 14" D Rack Model: 19" W x 8¾" H x 16¾" D
Net Weight:	Cabinet Model: 34 pounds Rack Model: 36 pounds
Shipping Weight:	Cabinet Model: 42 pounds Rack Model: 50 pounds
Price:	Cabinet Model: $335.00 F.O.B. Factory, Seattle, Washington Rack Model: $335.00 F.O.B. Factory, Seattle, Washington

Where applications require deleting all output terminals from front panel, the Model 407A (Cabinet Model) is available at $377.00 F.O.B. Factory, Seattle, Washington. All outputs plus the AC input are brought out through an AN 3102-28-9P connector located on the rear of the case.

MODEL 407R

HIGH VOLTAGE

High Resolution Nuclear Power Supply

MODEL 402M

500 — 1600 VDC

The Model 402M is a stable, well regulated source of DC voltage in the range of 500 to 1600 volts. The close regulation, high order of stability, and freedom from corona, output jitter and bounce make it an excellent voltage source for counters, multiplier photocells and other devices used in nuclear work. The Model 402M employs a high gain regulator system wherein a portion of the output voltage is compared with a reference voltage and the error amplified and applied to a series passing tube to effect correction. The sample portion is selected by a precision resistor string while a stabilized twin triode tube operated as a differential amplifier serves as the comparison element. Feedback systems are employed to reduce ripple and output impedance to a minimum.

Highest quality components and workmanship are employed throughout, ensuring long, trouble-free operation. The power transformer is of very conservative design, manufactured by this concern, and carries an unconditional lifetime guarantee against defects in material and workmanship.

SPECIFICATIONS

Input Voltage:	117 volts, 50/60 cycles, single phase Can be supplied for 234 volts, 50/60 cycles
Input Power:	20 watts fully loaded
Output Voltage:	500 to 1600 volts
Output Current:	0 to 1 milliampere
Output Polarity:	Positive or negative with respect to chassis, selected by front panel switch.
Regulation vs. Line:	.03% maximum for line change from 105 to 130 volts
Regulation vs. Load:	.03% no load to full load
Stability:	.01% per hour, .1% per day
Ripple:	Less than 5 mv RMS at any output voltage and current in either polarity mode
Voltage Calibration:	10-100 volt steps 1-100 volt vernier
Voltage Resolution:	100 mv at any output voltage
Calibration Accuracy:	Better than .5% by X100 control
Meters:	0-2kv 4" square. Better than 3% accuracy
Connectors:	See Page 15
Size:	19" W x 7" H x 13" D. Slotted to RMA standards. Equipped with resilient feet for bench use.
Net Weight:	22 pounds
Shipping Weight:	37 pounds
Finish:	Smooth grey, high-gloss, baked enamel, machine engraved.
Price:	$280.00 F.O.B. Factory, Seattle, Washington

Special models of the 402M are available with fixed voltage, fixed polarity and without meters. Please contact the factory for your special requirements.

HIGH VOLTAGE

High Resolution Nuclear Power Supply

MODEL 403M

The Model 403M is identical to the Model 402M, with the following exceptions:

Stability:	.02% per hour, .1% per day after warm-up.
Calibration Accuracy:	Better than 1% by X100 control.
Price:	$220.00 F.O.B. Factory, Seattle, Washington

Special models are available with fixed voltage, fixed polarity, and without meters. Please contact the factory for your special requirements.

HIGH VOLTAGE

High Resolution Nuclear Power Supply

500 TO 2000 VOLTS

MODEL 404M

FEATURES

- 500 to 2000 Volts Output
- 0 to 5 Milliamperes
- Selective Output Polarity
- Output Free from Jitter
- Zero Voltage Overshoot

The Model 404M is an extremely stable, highly regulated DC source covering the range of 500 to 2000 volts at 5 milliamperes.
Instantaneous output polarity reversal is accomplished by a switch on the front panel. Regulated output voltage is available by a connector on the rear skirt, in addition to the one on the front panel. A 1.02 volt sample of the output is available at a pair of binding posts on the front panel.
An anti-overshoot circuit is incorporated in the supply to prevent the output voltage from overshooting the pre-set level during warm up.

SPECIFICATIONS

Input Voltage:	117 volts, 50/60 cycles, single phase. Can be supplied for 234 volts, 50 60 cycles
Input Power:	45 watts fully loaded
Output Voltage:	500 to 2000 volts
Output Current:	0 to 5 ma, at 500-1500 V 0 to 2 ma, at 500-2000 V
Output Polarity:	Positive or negative with respect to chassis, selected by front panel switch
Output Connector:	See Page 15
Regulation vs. Line:	Better than .01% for line voltage change from 100 to 130 volts
Regulation vs. Line:	.01% maximum for 2 ma change
Stability:	Better than .005% per hour, .05% per day after warm up
Ripple:	Less than 5 mv RMS at any output voltage and current in either polarity
Voltage Calibration:	14-100 volt steps 1-100 volt vernier
Calibration Accuracy:	Better than .5% by X100 control
Voltage Resolution:	100 millivolts at any output setting
Voltage Overshoot:	None, under any conditions
Voltage Resettability:	Better than .1%
Meter:	0-2KV 4" square, 2% accuracy
Net Weight:	28 pounds
Shipping Weight:	42 pounds
Size:	19" W x 7" H x 13" D. Slotted to RMA Standards. Equipped with resilient feet for bench use.
Finish:	Smooth grey baked enamel, machine engraved
Price:	$435.00 F.O.B. Factory, Seattle, Washington

Special models are available upon request. Contact the factory for special requirements.

HIGH VOLTAGE

NUCLEAR POWER SUPPLY

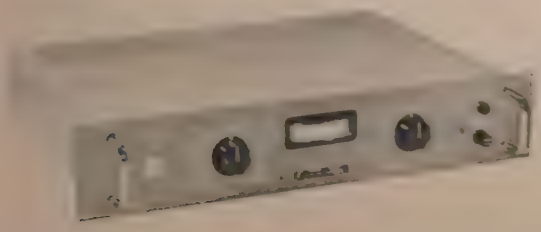
MODEL 409

170 — 1530 VDC

FEATURES

- 170 to 1530 Volts Output
- 0 to 5 Milliamperes
- Selective Polarity
- .02% Stability

The Model 409 is an extremely stable DC source covering the range of 170 to 1530 volts. The five milliampere output current capability permits simultaneous operation of several multiplier tubes. Circuit employs hermetically-sealed silicon rectifiers, power transformer and filter capacitors. Only highest quality Steatite and Mycalex switches are used.



SPECIFICATIONS

Input Voltage:	117 volts, 60 cycles, single phase
Output Voltage:	170 to 1530 volts DC
Output Current:	0 to 5 milliamperes over entire voltage range
Output Polarity:	Positive or negative—selective
Stability:	.02%
Output Connector:	See page 15
Ripple:	Less than .002% at any output voltage or current in either polarity
Regulation vs. line:	.01% max. for 10 volt line change
Regulation vs. load:	.4% max. for 1 milliampere load change
Stability:	.02% per day, after warm-up
Size:	19" W x 3½" H x 12" D. Equipped with removable resilient feet for beach use
Net Weight:	22 pounds
Shipping Weight:	34 pounds
Price:	$335.00 F.O.B. Factory, Seattle, Washington

HIGH VOLTAGE

High Stability Nuclear Power Supply

MODEL 405

600-3100 VDC

FEATURES

- 600-3100 VDC — 0 to 15 MA
- .005% Load Regulation
- Selective Output Polarity
- .005% Stability
- 10 Millivolt Resolution
- Excellent Long-term Stability

The Model 405 is a highly stable, calibrated, high voltage power supply free from bounce, jitter and corona. Residual ripple is less than 5 millivolts under all conditions. This model employs precision wirewound sampling circuits, differential amplifiers and a tetrode series passing tube to achieve an extremely stable output free from the annoying effects of line voltage and load current fluctuations.

Additional features include an instant resetting anti-overshoot circuit to positively prevent output voltage overshooting the pre-set level under all conditions of start-up, shut-down, temporary power failure, etc.

Calibrated voltage controls accurate to .5% provide setting output voltage to any desired level with a resolution of 10 millivolts.

Special models of the 405 can be furnished for fixed voltage and fixed polarity applications. They can be supplied without output voltage controls, polarity switch or meter. Where the application of the supply is such that it may be affected by environmental conditions such as dust, dirt, sand, etc., the Model 405F is recommended. The Model 405F is a totally enclosed unit equipped with blower and dust filter.

SPECIFICATIONS

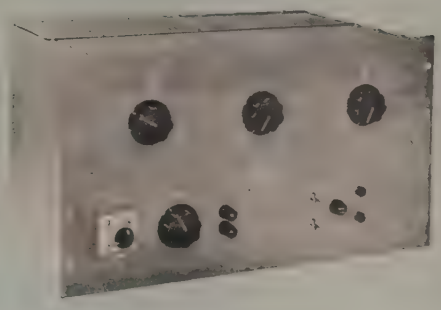
Input Voltage:	117 volts, 50/60 cycles, single phase. Can be supplied for 234 volts, 50/60 cycles.
Output Voltage:	600 to 3110 volts dc
Output Current:	0 to 15 milliamperes dc
Output Polarity:	Positive or negative with respect to chassis, selected via front panel switch
Monitoring Output:	1.02 volt sample for potentiometric monitoring at front panel binding posts.
Connectors:	See page 15.
Regulation vs. Line:	.01% maximum for line voltage variation from 105 to 130 volts.
Regulation vs. Load:	.005% for 10MA load change.
Stability:	.005% per hour, .05% per day after warmup.
Ripple & Jitter:	Less than 5MV RMS at any output voltage and current in either polarity.
Voltage Calibration:	2 -1000 volt steps 1 - 400 volt step 10- 100 volt steps 10- 10 volt steps 1 - 10 volt vernier
Voltage Resolution:	10 millivolts at any output voltage.
Calibration Accuracy:	Better than .5%.
Size:	19" W x 10½" H x 14" D. Slotted to RMA standards. Equipped with resilient feet for bench use.
Net Weight:	49 pounds.
Shipping Weight:	63 pounds.
Finish:	Smooth grey, baked enamel. Panel machine engraved.
Price:	Model 405. $595.00 F.O.B. Factory, Seattle, Washington. Model 405F. $635.00 F.O.B. Factory, Seattle, Washington.

HIGH VOLTAGE

High Resolution Nuclear Power Supply

MODEL 400BDA

500 TO 5100 VOLTS



FEATURES

- 500 to 5100 VOLTS OUTPUT
- 0 TO 1 MILLIAMPERE
- SELECTIVE OUTPUT POLARITY
- ABSOLUTE FREEDOM FROM JITTER
- NEGLIGIBLE RIPPLE (5 MV MAX.)
- .01% LINE REGULATION
- .01% LOAD REGULATION
- EXCELLENT LONG TERM STABILITY

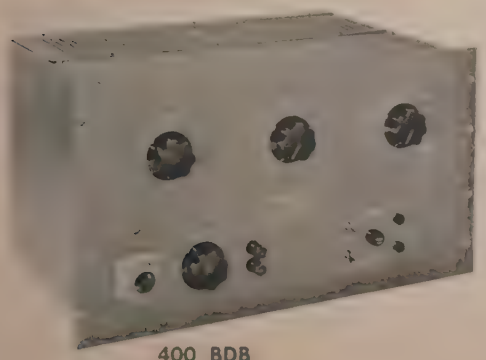
The Model 400BDA is an extremely stable, highly regulated source of DC voltages in the range of 500 to 5100 volts. Careful attention to component selection and circuit layout and very conservative transformer design and assembly procedures have resulted in a noise free DC output instantly reversible in polarity by a simple front panel switch. The complete freedom from annoying jitter, bounce, and corona make the Model 400BDA the logical first choice for the exacting requirements of photomultiplier, proportional counter and ionization chamber work.

The Model 400BDA employs a high gain regulator system wherein a portion of the output voltage is compared with a reference voltage and the error amplified and applied to a special high mu series passing tube to effect correction. Selection of the sample portion is accomplished by a precision wire wound resistor network and the reference voltage is derived from type 5651 reference tubes operated at constant current from a .05% regulated auxiliary supply. The comparison element is a stabilized dual triode operated as a differential amplifier. Feedback systems are employed to reduce ripple and output impedance to a minimum.

A switch with pilot light is provided for removing high voltage from the output connector while leaving the supply in standby condition. A 1.02 volt sample of the output voltage is made available at a pair of front panel binding posts for potentiometric monitoring of the output. Calibrated output voltage controls accurate to .5% provide for setting output voltage to any desired level with a resolution of 50 millivolts.

SPECIFICATIONS

Input Voltage:	117 volts, 50/60 cycles, single phase. Can be supplied for 234 volts, 50/60 cycles.
Input Power:	65 watts fully loaded.
Output Voltage:	500 to 5100 volts.
Output Current:	0 to 1 milliampere.
Output Polarity:	Positive or negative with respect to chassis, selected by front panel switch.
Output Connector:	See page 15.
Regulation vs. Line:	.01% maximum from 100 to 130 line volts.
Regulation vs. Load:	.01% maximum, no load to full load.
Stability:	Better than .005% per hour, .05% per day after warmup.
Ripple:	5 millivolts maximum at any output voltage and current in either polarity mode.
Voltage Calibration:	4-1000 volt steps. 1-500 volt step. 10-100 volt steps. 1-100 volt calibrated vernier.
Voltage Resolution:	50 millivolts at any output setting.
Calibration Accuracy:	Better than .5%.
Size:	19" W x 10½" H x 12½" D. Slotted to RMA standards. Equipped with resilient feet for bench use.
Net Weight:	42 pounds.
Shipping Weight:	56 pounds.
Price:	$595.00 F.O.B. Factory, Seattle, Washington



400 BDB

HIGH VOLTAGE NUCLEAR SUPPLY

1000-6100 VDC

The Model 400BDB is identical to the Model 400BDA with the following exceptions:

Output Voltage:	1000-6100 Volts DC.
Output Current:	0 to 250 microamperes.
Voltage Calibration:	5-1000 volt steps. 10-100 volt steps. 1-100 volt vernier.
Price:	$595.00 F.O.B. Factory, Seattle, Washington

PRECISION DIFFERENTIAL VOLTMETER

MODEL 800

FEATURES

- 0 to 500 Volts DC
- Infinite Input Resistance at Null
- Accuracy .05% of Actual Reading
- Standard Cell Reference
- Resolution .01 Volt Directly from Calib. Controls
- Search Range for Rapid Voltage Approximation
- Multipliers Available for use to 5KV

PRECISE DC VOLTMETER WITH INFINITE INPUT RESISTANCE

The Model 800 Differential DC Voltmeter is an electronic instrument for the precise measurement of DC voltages. It is a true potentiometer and permits the rapid measurement of DC voltages up to 500 volts to an accuracy of .05%, with absolutely no source loading. A convenient 500-0-500 volt "search" range with 10 megohms input resistance is provided for quickly locating the unknown voltage in the 500 volt spectrum prior to the .05% measurement in the differential mode. Two calibrated burn-out proof null ranges of 10 and 1 volt full scale sensitivity provide excellent resolution and permit observation of voltage excursions in the source under measurement. The Model 800 Differential Voltmeter utilizes printed circuits and aluminum construction throughout to achieve a light weight, rugged and modern portable instrument for rapid accurate measurement of DC voltages on production and test lines, in the laboratory and in the field. A mirror scale meter using sapphire, spring-mounted pivots facilitates precise nulling.

SPECIFICATIONS

Input Voltage:	117 volts, 50/60 cycles single phase. Can be supplied for 234 volts, 50/60 cycles.
Voltage Range:	0 to 500 volts DC.
Input Resistance:	Infinite at null as indicated by zero deflection of the meter. 2000 megohms per volt of input voltage for 0.005 volt unbalance as indicated by meter.
Scales:	1-0-1 volt DC. 10-0-10 volts DC.
Accuracy:	.05% of actual voltage from 10 to 500 volts. .1% of actual voltage, or 5 mv, whichever is greater, below 10 volts.
Resolution:	0.01 volt read directly on calibrated controls. Greater resolution available by reading meter.
Size:	Cabinet Model: 9¾" W x 13" x 14" D. Rack Model: 19" W x 8¾" H x 16¾" D.
Finish:	Smooth grey panel. Grey baked wrinkle case.
Net Weight:	Cabinet: 20 pounds. Rack: 20 pounds.
Shipping Weight:	Cabinet: 27 pounds: Rack: 34 pounds.
Price:	Cabinet Model: $355.00 F.O.B. Factory, Seattle, Washington. Rack Model: $355.00 F.O.B. Factory, Seattle, Washington

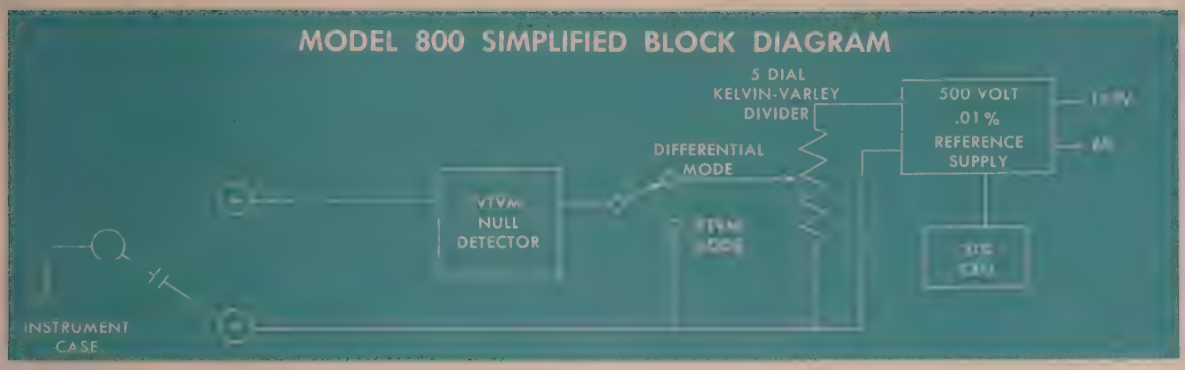
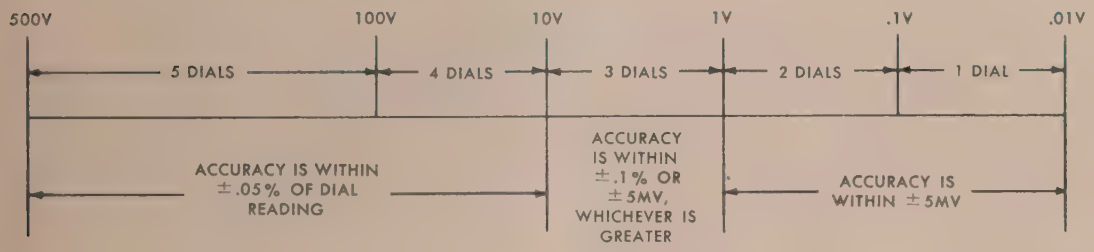


FIG. 1

MODEL 800—ACCURACY VS INPUT VOLTAGE



This diagram shows the limits of accuracy and the number of dials (Kelvin-Varley divider) in use as a function of input voltage

FIG. 2

MODEL 800R

Precision Potentiometric DC Voltmeter

MODEL 801

FEATURES

- Accuracy .05% of input voltage from 500 to .1 volt
- Four potentiometric ranges
- Infinite input resistance at null
- Eight search and VTVM ranges
- Standard Cell Reference
- Automatic lighted decimal for fast, direct read-out

The Model 801 Precision Potentiometric DC Voltmeter is a sensitive, highly accurate true potentiometer. It is self contained, portable, and virtually impossible to damage by accidental overload. Basic elements of the 801 are a standard cell, an extremely stable 500 volt reference source, a precision five-dial Kelvin-Varley voltage divider and a chopper stabilized null detector. In order to set the reference voltage with high accuracy, the standard cell comparison circuit is factory-set precisely to the actual standard cell voltage available in each instrument. This procedure eliminates resistor tolerances in the comparison circuit. The same approach is used in the decade dividers resulting in these strings having an accuracy of better than .01%. Resistors on the five Kelvin-Varley dials are matched to each other and, in turn, the completed dials are matched units. The chopper-stabilized null detector in the Model 801 has exceptionally high stability allowing true null to be determined accurately. This stability plus the four ranges of the detector further insure accuracy and ease of operation.

SPECIFICATIONS

AS A PRECISION POTENTIOMETER

RANGES:

Input Voltage Range	*Null Voltage Ranges	Input Resistance per volt of input voltage At Null	1% Off Null
50-500	10-0-10	Infinite	100 Meg
	1-0-1	Infinite	1000 Meg
5-50	1-0-1	Infinite	1000 Meg
	.1-0-.1	Infinite	1000 Meg
.5-5	.1-0-.1	Infinite	1000 Meg
	.01-0-.01	Infinite	10000 Meg
0-.5	.1-0-.1	Infinite	1000 Meg
	.01-0-.01	Infinite	10000 Meg

*Any null range may be used with any input voltage range; recommended ranges are shown above.

ACCURACY: ± .05% of input voltage from .1V to 500V; below .1V ± .1% of input voltage or .00005V whichever is greater.

RESOLUTION:

Input Voltage Range	Dial Limits Volts	Meter Limits on Rec. Null Range Volts
50-500	.01	.005
5-50	.001	.0005
.5-5	.0001	.00005
0-.5	.00001	.00005

AS A VACUUM TUBE VOLTMETER

Voltage Ranges: ±500, ±50, ±5, ±.5 and ±10*, ±1*, ±.1*, ±.01* volts dc full scale.
*These ranges obtained by setting null range to desired sensitivity and five voltage dials to zero.

Input Resistance: 10 megohms for all voltage ranges except .1 and .01 which have 1 megohm input resistance.

Accuracy: ±4% of full scale value.

GENERAL FEATURES

Stability of Reference: ±.01% for 25% change in line voltage.

Settability of Reference: ±.01% per hour after 30 min. warm up.
Reference supply can be set to 500 volts ±.01% or better against built-in standard cell.

Stability of Meter Reading: 4% of full scale for 25% change in line voltage.

Input Voltage: 117 volts, 50/60 cycles, single phase. Can be supplied for 234 volts, 50/60 cycles.

Size: Cabinet Model: 9¾" W x 13" H x 14" D.
Rack Model: 19" W x 8¾" H x 16¾" D.

Net Weight: Cabinet Model: 22 pounds.
Rack Model: 21 pounds.

Shipping Weight: Cabinet Model: 29 pounds.
Rack Model: 35 pounds.

Price: Cabinet Model: $485.00 F.O.B. Factory, Seattle, Washington
Rack Model: $485.00 F.O.B. Factory, Seattle, Washington

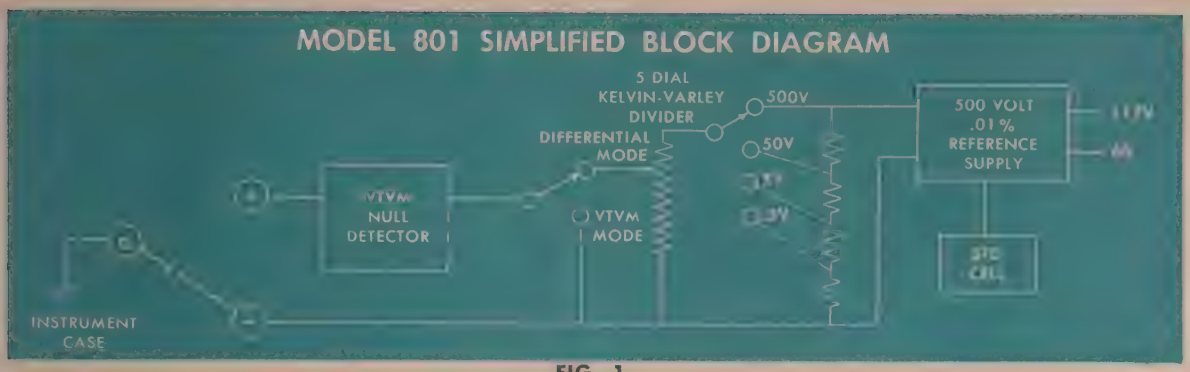
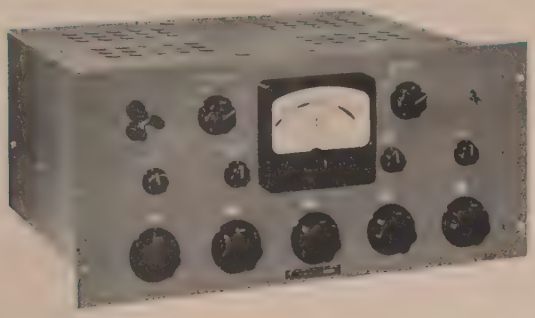
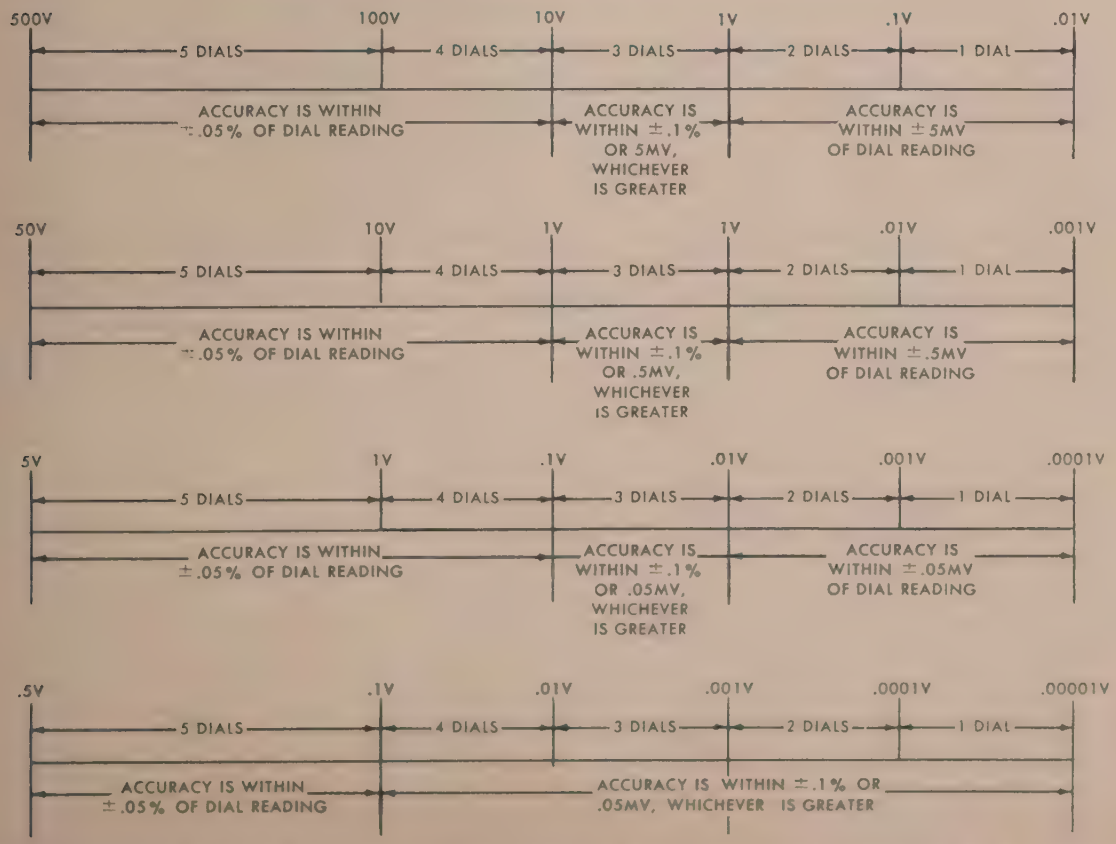


FIG. 1

MODEL 801R



MODEL 801—ACCURACY VS INPUT VOLTAGE



This diagram shows the limits of accuracy and the number of dial: (Kelvin-Varley divider) in use as a function of input voltage.

FIG. 2

Precision DC-AC Differential Voltmeter

MODEL 803

FEATURES

DC
- Accuracy .05% of input voltage
- Four search ranges and four null sensitivities
- Infinite input resistance at null

AC
- Accuracy .2% of input voltage
- Converter frequency response 30 cps to 5 kc
- Measures RMS value of true sine wave

- DIRECT IN-LINE READOUT
- STANDARD CELL REFERENCE
- AUTOMATIC LIGHTED DECIMAL

The Model 803 DC-AC Precision Differential Voltmeter is a compact, highly accurate, portable voltmeter designed for precision measurement of DC or AC voltages. Ease of operation and inherent protection from accidental overload, combined with high accuracy and resolution, assure equal suitability for production line testing or precision laboratory measurements. The instrument may be used as a vacuum tube voltmeter, as a differential DC voltmeter, or as a differential AC voltmeter. No delay is encountered when switching from one type of measurement to another. The front panel controls are arranged so that all measurements involve simple, systematic adjustment of the controls. The value of the unknown voltage is directly displayed on an in-line read-out—complete with an automatically lighted decimal point. It is possible to make precise measurements of a stable voltage, or to observe and measure relatively slow excursions about an average level of voltage. Highest quality components conservatively rated are employed throughout, insuring stable, trouble-free operation. Basic elements of the 803 are a standard cell, a 500 volt reference source and precision decade divider, a chopper stabilized null detector and an extremely stable DC to AC converter. Connection of these is shown, in simplified form, in the block diagram.

SPECIFICATIONS

AS A DIFFERENTIAL VOLTMETER

VOLTAGE RANGES:

	Input Voltage Range	Recommended Null Range	Input Impedance At Null	Input Impedance 1% Off Null
DC	50-500	10-0-10	INFINITE	100M
		1-0-1	"	1000M
	5-50	1-0-1	"	1000M
		.1-0-.1	"	1000M
	.5-5	.1-0-.1	"	1000M
		.01-0-.01	"	1000M
	0-.5	.1-0-.1	"	10000M
		.01-0-.01	"	10000M
AC	50-500	10-0-10	1M, 25 uuf	1M, 25 uuf
		1-0-1	"	"
	5-50	1-0-1	"	"
		.1-0-.1	"	"
	.05-5	.1-0-.1	"	"
		.01-0-.01	"	"

RESOLUTION:

	Input Voltage Range	Dial Resolution (Volts)	Meter Resolution (Volts)
DC	50-500	.01	.005
	5-50	.001	.0005
	.5-5	.0001	.00005
	0-.5	.00001	.00005
AC	50-500	.01	.005
	5-50	.001	.0005
	.05-5	.0001	.00005

ACCURACY:

DC ± .05% OF INPUT VOLTAGE FROM .1 TO 500V
± .1% OF INPUT VOLTAGE OR .00005V, WHICHEVER IS GREATER FROM 0 TO .1V

AC ± .2% OF INPUT VOLTAGE FROM .5 TO 500V, REDUCED ACCURACY FROM .05 TO .5V

AS A VACUUM TUBE VOLTMETER

VOLTAGE RANGES:

	Input Voltage Range	Input Impedance
DC	± 500	10M
	± 50	10M
	± 5	10M
	± .5	10M
	± 10 *	10M
	± 1 *	10M
	± .1 *	1M
	± .01 *	1M
AC	0-500	1M, 25 uuf
	0-50	"
	0-5	"
	0-100 *	"
	0-10 *	"
	0-1 *	"
	0-.1 *	"
	0-.01 *	"

*Using Null Ranges

GENERAL SPECIFICATIONS

REFERENCE STABILITY:
± .01% FOR 25% CHANGE IN LINE VOLTAGE
± .01% PER HOUR AFTER 30 MINUTE WARMUP

AC TO DC CONVERTER FREQUENCY RESPONSE:
30 CPS TO 5000 CPS

INPUT POWER: 175 WATTS AT 117/234 VOLTS, 50/60 CYCLES

SIZE: CABINET MODEL—13" H x 9¾" W x 16" D

NET WEIGHT: CABINET MODEL—30 POUNDS

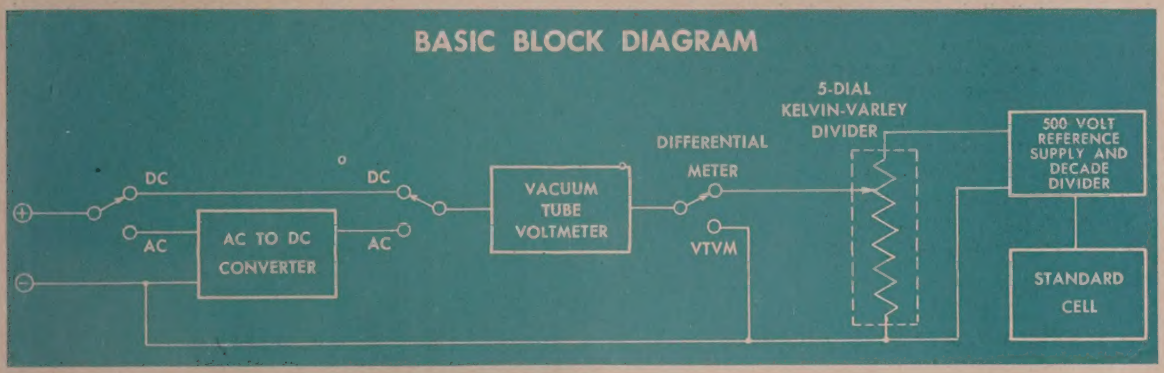
SHIPPING WEIGHT: CABINET MODEL—38 POUNDS

PRICE: $845.00 F.O.B. FACTORY, SEATTLE, WASH.

MECHANICAL FEATURES

Careful mechanical design consideration was given to provide convenient accessibility to all circuit components. Substantially all circuitry is in printed form. The printed circuit boards are arranged so that their circuit sides are accessible simply by removing the instrument case. Key printed circuit boards are the plug-in type and may be readily removed to gain access to internal components. The front panel may be swung open when the case is removed, providing access to the precision components located near the front of the instrument. All calibration adjustments may be made without removing the instrument from the case.

BASIC BLOCK DIAGRAM



ACCESSORIES

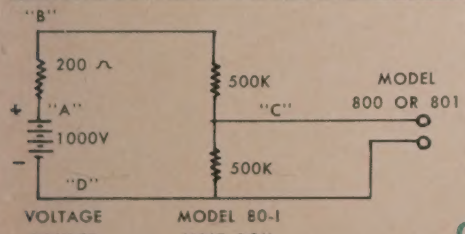
MODEL 80 VOLT BOXES

Both the Model 800 and the Model 801 differential voltmeters may be used to measure voltages in excess of 500 volts by using an appropriate voltage divider or "volt box" to attenuate the EMF under measurement to 500 volts or less.

The three chief requirements of a voltage divider or "volt box" for use with the Models 800 and 801 are extreme accuracy of the division ratio, very low temperature coefficient of resistance, and excellent long term stability. The last two requirements automatically rule out all composition, deposited carbon and metal film resistors. The only type suitable is a properly aged precision wire-wound unit wound with Evanohm or equivalent alloy.

The John Fluke Mfg. Co. has made available a series of volt boxes which meet the above requirements. These are the Model 80 series, and a list of the ranges available follows:

MODEL NO.	DIVISION RATIO	MAXIMUM INPUT	TOTAL RES.	CURRENT DRAWN AT MAX. INPUT	PRICE
80-1	2:1	1 KV	1 megohm	1 MA	$ 60
80-2	4:1	2 KV	2 megohms	1 MA	70
80-3	6:1	3 KV	3 megohms	1 MA	80
80-4	8:1	4 KV	4 megohms	1 MA	90
80-5	10:1	5 KV	5 megohms	1 MA	100
80-6	2:1	1 KV	10 megohms	0.1 MA	120

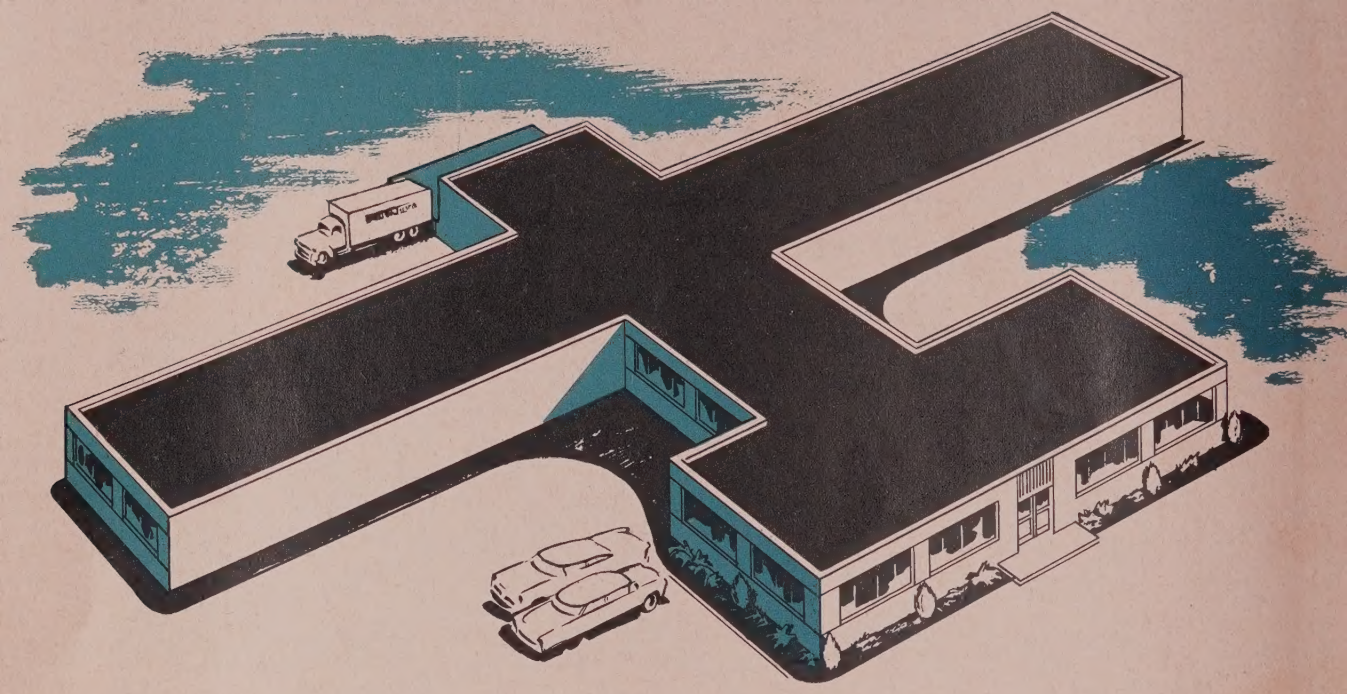


The division ratio of all models is accurate to .01% and long term stability is better than .01% per year. All models are housed in black phenolic boxes measuring 5¼" wide x 6¾" long x 2¼" deep. Output terminals are General Radio polystyrene on ¾" centers, and the input is brought out by a pair of 6-foot flexible leads. The "hot" lead is made of a special high voltage wire insulated for better than 10 KV.

CONNECTORS

All high voltage power supplies, with the exception of the jf Model 409, are provided with 2 each AN-3102-18-16S connectors, one on front panel, one on rear skirt. One mating connector is furnished with each instrument at no additional charge. Special connectors available on request.

The Model 409 is provided with 2 each UG/931-U connectors, one on front panel, one on rear skirt. One mating connector furnished at no additional charge. Special connectors are available for this instrument; however, choice is limited to connector on rear skirt only.



The John Fluke Manufacturing Co., Inc. has chosen competent, independent representative organizations who specialize in instrumentation and applications. Below is a list of these companies who are at your disposal for discussions or demonstrations of our equipment.

UNITED STATES AND CANADIAN REPRESENTATIVES

ALBUQUERQUE, NEW MEXICO
Gene French Company
120 San Pedro S. E.
Albuquerque, New Mexico

ATLANTA, GEORGIA
Bivens & Caldwell, Inc.
3133 Maple Drive N. E.
Atlanta 5, Georgia

BALTIMORE, MARYLAND
Horman Associates, Inc.
3006 W. Cold Spring Lane
Baltimore 15, Maryland

BOSTON, MASSACHUSETTS
Technical Instruments, Inc.
90 Main Street
Reading, Massachusetts

BRIDGEPORT, CONNECTICUT
Technical Instruments, Inc.
1115 Main Street
Bridgeport, Connecticut

CHICAGO, ILLINOIS
Cozzens & Cudahy, Inc.
845 Chicago Avenue
Evanston, Illinois

CLEVELAND, OHIO
M. P. Odell Company
26614 Center Ridge Road
Westlake, Ohio

DALLAS, TEXAS
Wallace-Gluck Company
P. O. Box 13203
Dallas 20, Texas

DAYTON, OHIO
M. P. Odell Company
2676 Salem Avenue
Dayton, Ohio

DENVER, COLORADO
Gene French Company
3395 South Bannock Street
Englewood, Colorado

DETROIT, MICHIGAN
M. P. Odell Company
10531 W. McNichols Road
Detroit 21, Michigan

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Technical Instruments, Inc.
119 Ann Street
Hartford, Connecticut

HIGH POINT, NORTH CAROLINA
Bivins & Caldwell, Inc.
P.O. Box 5187
High Point, North Carolina

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Harris-Hanson Co.
7916 Paseo Avenue
Kansas City 30, Missouri

LOS ANGELES, CALIFORNIA
McCarthy Associates, Inc.
1055 East Walnut Street
Pasadena, California

MINNEAPOLIS, MINNESOTA
Pinkney & Hine Company
1925 Nicollet Avenue
Minneapolis 3, Minnesota

NEW YORK, NEW YORK
G. Curtis Engel & Associates
210 South Broad Street
Ridgewood, N. J., RE 2-0001

ORLANDO, FLORIDA
Bivins & Caldwell, Inc.
P. O. Box 6025, Tel: CH 1-1091
Orlando, Florida

PHILADELPHIA, PENNSYLVANIA
G. Curtis Engel & Associates
P. O. Box 4383, WAlnut 2-3270
Philadelphia 18, Pennsylvania

PITTSBURGH, PENNSYLVANIA
M. P. Odell Company
750 Penn. Avenue
Pittsburgh 21, Pennsylvania

RIDGEWOOD, NEW JERSEY
G. Curtis Engel & Associates
210 South Broad Street
Ridgewood, New Jersey

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934 W. Laurel Street
San Diego 1, California

SAN FRANCISCO, CALIFORNIA
McCarthy Associates, Inc.
635 Oak Grove Avenue
Menlo Park, California

SEATTLE, WASHINGTON
Rush S. Drake Associates
1806 Bush Place
Seattle 44, Washington

ST. LOUIS, MISSOURI
Harris-Hanson Company
2814 S. Brentwood Blvd.
St. Louis 17, Missouri

SYRACUSE, NEW YORK
J. D. Ryerson Associates, Inc.
P. O. Box 1400
Syracuse 1, New York

TORONTO, ONTARIO, CANADA
The Glendon Company, Ltd.
44 Wellington Street East
Toronto 1, Ontario, Canada

VANCOUVER, B.C., CANADA
Rush S. Drake Associates
1806 Bush Place
Seattle 44, Washington

WASHINGTON, D. C.
Horman Associates
941 Rollins Avenue
Rockville, Maryland

EXPORT REPRESENTATIVES

AD Auriema, Inc.
85 Broad Street
New York 4, New York
Africa, Australia, France, Great Britain, Indonesia, Ireland, Israel, Italy, Japan, Mexico, New Zealand, Portugal, Scotland, South and Central America, Spain.

Berg-Hedstrom & Co., Inc.
1170 Broadway, New York 1, New York
Cable address: JONSTROM
Belgium, Denmark, Finland, Germany, Holland, Norway, Sweden, Switzerland.

The right is reserved, without notice, to make such changes in equipment, design, or components as engineering or manufacturing progress may warrant.

Prices subject to change without notice.

METROPOLITAN AND WESTCOTT LITHO IN U.S.A.

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